data, and calculates non-dimensional coefficients (Prandtl's number Reynolds number, Biot number, Nusselt number and friction factors) needed to produce generalized correlations of the heat transfer process thereby enhancing data representation. Data reduction software provides a module to process and repeat high temperature heat transfer experiments. It will subsequently introduce new experiments to improve the cooling process. The APS beam strike surface is limited by thermo-mechanical design criteria. However, by promoting enhanced heat transfer experiments, safe operation and longevity of the X-ray beam life are promoted.

Environmental Science

An Enclosure Study to Investigate the Causes of the decline of Southern Leopard Frogs (*Rana sphenocephala*) on Long Island. *Duncan Adams* (*Earlham College, Richmond, IN*); *Jeremy Feinberg* (*Brookhaven National Laboratory, Upton, NY*). Around the world amphibian species are declining at unprecedented rates due to a variety of causes. Some, such as habitat loss, are readily observable, while some amphibian declines are not as well understood. The southern leopard frog (*Rana sphenocephala*) is an anuran native to much of the eastern United States, including Long Island, New York. Formerly one of the most visible and abundant frog species on Long Island, it has declined over the last 30 to 50 years to the point that there has not been a confirmed sighting since 1998. This possible extirpation could be due to habitat loss, environmental contamination, disease, invasive vegetation, interspecific competition, or any combination of these factors. In order to test these hypotheses leopard frog tadpoles were used as bio indicators. Leopard frog eggs were collected from southern New Jersey and placed in screen enclosures located in Long Island wetlands. Measurements of the tadpoles will be collected weekly and dead tadpoles tested for disease and toxicity. Tadpole growth and survival rates for the different conditions will indicate the relative importance of competition, disease, and plant community to the leopard frog. In following years similar experiments will be done to test the same and other factors in southern leopard frog decline on Long Island. The use of leopard frog tadpoles as bio-indicators this year and subsequent findings will help to identify possible sites of relic populations, as well as allowing the design of more effective conservation efforts for southern leopard frogs and similar species.

Characterization of the Sunset Semi-Continuous Carbon Aerosol Analyzer. *Jace Bauer* (*Purdue University, West Lafayette, IN*) *Xiao-Ying Yu* (*Pacific Northwest National Laboratory, Richland, WA*). Atmospheric carbonaceous aerosols play a key role in climate forcing and global change. *In-situ* quantification of carbonaceous aerosols is therefore essential to reduce uncertainty in climate change models as well as for long-term monitoring by government agencies. The field deployable Sunset Semi-Continuous Organic Carbon/Elemental Carbon Aerosol Analyzer (Sunset OCEC) utilizes a modified National Institute for Occupational Safety and Health (NIOSH) thermal-optical method to determine total carbon (TC), organic carbon (OC), and elemental carbon (EC). It can provide *in-situ* semi-continuous measurements on an hourly basis; however, its performance is not yet fully characterized. Two collocated Sunset OCECs, identified as 'Unit A' and 'Unit B,' were used to characterize the relative standard deviation (RSD) and limit of detection (LOD) between June 23 and July 9, 2007 in Richland, WA. A high efficiency particulate air (HEPA) filter was utilized to determine the LODs of both instruments. The RSDs between the two Sunset OCECs are 9.1% for TC, 13.0% for optical OC, and 9.0% for thermal OC, indicating good precision between the instruments. In addition, the RSD for thermal EC is 29.0%, while optical EC is 48.3%. The LOD for Unit A is approximately 0.21 µgC/m3 for TC, optical OC, and thermal OC and ~0.004 µgC/m^3 for optical and thermal EC. Similarly, Unit B has an LOD of ~0.29 µgC/m^3 for TC, optical OC, and thermal OC, 0.018 µgC/m^3 for optical EC, and 0.004 µgC/m^3 for thermal EC. Several factors may have contributed to the poor RSDs of thermal and optical EC. First, the low EC mass loading at this location caused uncertainty in the measurements. Second, Unit B EC measurements were affected by a leakage in the oxygen valve. Third, the non-dispersive infrared detector in Unit B displayed excessive "noise," resulting in scattered optical EC measurements, which consequently worsened the comparison between Unit A and Unit B. Improved RSDs of all OC and EC parameters are expected after Unit B is repaired. Future work should reevaluate the precision of the Sunset OCECs and investigate the difference in various thermal-optical protocols on OCEC quantification.

Impacts of Mercury Emissions from Coal-Fired Power Plants in Western Pennsylvania. *Michele Bender* (*Mount Saint Mary College, Newburgh, NY*); *Carlos Bu* (*Monroe Community College, Rochester, NY*); *John Heiser, Terry Sullivan* (*Brookhaven National Laboratory, Upton, NY*). Mercury, a neurotoxin, is toxic to humans, especially in the brain, nervous system, kidney, and liver. Power plants are the biggest source of mercury emissions in the United States. When fully implemented by the U.S. Environmental Protection Agency (EPA), the Clean Air Interstate Rule and the Clean Air Mercury Rule will lead to a reduction in mercury emissions from coal-fired power plants by 70% to 15 tons per year by 2018. The EPA estimates that due to these higher restrictions mercury deposition will be reduced 8% on average in the eastern United States. A concern exists that the deposition of mercury near power plants will be much greater than average, leading to a "hot spot" where exposure may be greater than desired. For this study, a "hot spot" is defined as an area no less than four square miles with a mercury concentration higher than the average by one standard deviation. The goal of this study is to determine the effect of three coal-fired power plants on the surrounding environment in western Pennsylvania. During the growing season, oak leaves collect deposited mercury from the power-plant emissions and have a large surface area to collect mercury. The study focused on oak leaves from leaf litter within a five-mile radius of each power plant. Sample collection began with mapping of the area around the power plants to determine easy access locations within circular sampling rings, and collection of oak leaves from the leaf litter at the sampling locations. The samples collected were dried, ground into small particles, and processed using a Direct Mercury Analyzer to calculate the mercury content in the samples. After the results were collected, the data was analyzed to determine if "hot spots" occurred. The results did not indicate a "hot spot" in the region near the power plant. However, the information shows a possible effect of the power plants increasing mercury concentration in a southeast direction, consistent with the prevailing wind pattern. The data shows a possible correlation of elevation increasing deposition, but the data is not conclusive. Therefore, the power plants had little impact on the presence of a "hot spot" on the surrounding area.

Post-Breeding Dispersal and Terrestrial Habitat Use by Woodhouse's Toad (*Bufo woodhousii*) on the Hanford Reach National Monument. *Shannon Blackburn* (*Western Washington University, Bellingham, WA*); *James Becker* (*Pacific Northwest National Laboratory, Richland, WA*). Anurans serve as key biological indicators of environmental health due to their use of both terrestrial and aquatic habitats and permeable skin. However, knowledge regarding terrestrial habitat use is relatively unknown. The purpose of this study was to evaluate the post-breeding dispersal, aestivation locations, and identify terrestrial habitat use of Woodhouse's toads (*Bufo woodhousii*) at the Hanford Reach National Monument. We used radio-telemetry to track the movements of thirty-two Woodhouse's toads from July 13th–August 20th, 2007 at two pools after cessation of most breeding activity. We found that during late-breeding season and summer aestivation, adult Woodhouse's toads utilize a variety of different environments; temporary and permanent pools, wetlands, and dry upland areas up to 1.12 km away from the breeding site. The observed mean distance, the sum of linear movements between locations, was 479 m and toad movement was not significantly correlated with snout-vent-length (R2=0.0588). The toads were observed burying in fine sand, silts, and clays in exposed areas, underneath vegetation litter, and in small animal burrows. Woodhouse's toads had significantly shorter movements at the pool with a dense community of tall grasses than at the pool with a drier, anthropogenic-modified habitat.

Study of Chloride Mass Balance Preparations. *Chase Bovaird* (*The George Washington University, Washington, DC*); *Jeff Serne* (*Pacific Northwest National Laboratory, Richland, WA*). Chloride Mass Balance (CMB) is an inexpensive and effective way to estimate groundwater recharge in arid or semi-arid environments. CMB analysis is important to the Hanford Site in its ongoing environmental cleanup efforts, in that estimation of contaminant flow is important to regulators. Past studies have resulted in data that show an increase in chloride concentration when 1:1 water extracts are prepared by oven drying or when the water is allowed a prolonged contact time with the sediment. Using 1:1 water extract method with air dried and oven dried sediments, chloride analyses were performed with an ion-chromatograph mass spectrometer (IC-MS). Analysis with IC-MS was also performed on 1:1 sediment-water extracts after contact times of 1, 3, and 7 days. Expected results, commensurate with assumptions made in CMB analysis should show neither chloride loss from porewater from oven drying sediment nor an increase. Further, there should be no increase

or decrease in chloride concentration in the water extracts with increasing contact time. This project is part of a larger work on CMB and should help in standardizing/optimizing the procedure. Preliminary results show that there are several complications in steps used to obtain the water extract and in the analysis of chloride that are making the application of CMB problematical for Hanford environments where recharge rates are larger than a few mm/yr. Further, the Hanford sediments may be a source or readily leachable chloride during the water extract process that is not present in the actual porewater

Increasing the Accuracy of Global Irradiance Calculations: An Analysis of Responsivities and Correction Methods. *Liza Boyle* (*University of the Pacific, Stockton, CA*)*; Stephen Wilcox* (*National Renewable Energy Laboratory, Golden, CO*). In an effort to make solar radiation data more accurate for solar energy system and climate change research there have been many advances in solar radiometer calibration leading to the creation of several different pyranometer responsivities and correction methods. Here we study the accuracy of four responsivities — "responsivity (45º)", "responsivity function", "responsivity (45°) corrected", and "responsivity function corrected" — and three correction methods — "Reda" (which relates directly to the two corrected responsivities), "Dutton", and "Full." Data was gathered from the National Renewable Energy Laboratory and Atmospheric Radiation Measurement program, Southern Great Plains sites, over a two and half year period. The average difference, or deltas, between a reference irradiance, determined from independent direct and diffuse irradiances, and the irradiance calculated from pyranometer data using these different methods was examined. The averages and standard deviations of these deltas indicate the accuracy and precision of the pyranometer data. Analysis of data showed that the "responsivity function" reduced the zenith angle dependence apparent in the "responsivity (45°)", decreasing the overall standard deviation of the deltas from 15.15 W/m^2 to 11.74 W/m^2. Average deltas decreased from 4.40 W/m^2 to 1.46 W/m^2 by using the "responsivity function". Analysis also showed that "responsivity (45°) corrected" slightly decreased the average delta of the "responsivity (45°)" data from 4.40 W/m^2 to 1.56 W/m^2, while keeping the scatter relatively constant, 15.15 W/m^2 to 13.45 W/m^2 respectively. The "responsivity function corrected" slightly increased the average delta of the "responsivity function" data from 1.46 W/m^2 to 1.51 W/m^2, while keeping the scatter relatively constant, 11.74 W/m^2 to 12.31 W/m^2 respectively. When applied to "responsivity (45°)" data, the "Dutton" and the "Full" methods reduced the average delta from 4.40 W/m^2 to 0.23 W/m^2 and 0.97 W/m^2 respectively, but increased scatter from 15.15 W/m^2 to 16.26 W/m^2 and 16.13 W/m^2 respectively. These results indicate that that "responsivity function" and "responsivity function corrected" have the greatest accuracy and least uncertainty. Further studies are needed to understand why the "Dutton" and "Full" methods increase scatter, understand all of the trends revealed in the data, and compare other responsivities and correction methods with those analyzed in this study.

Characterization and Performance of the Zonal Exposure to Broadband RAdiation (ZEBRA) Shadowband. *Sarah Braden* (*Northwestern University, Evanston IL*)*; Daryl Myers* (*National Renewable Energy Laboratory, Golden, CO*). Cost-effective measurement of solar radiation resources is a worldwide problem. The Zonal Exposure to Broadband RAdiation (ZEBRA) shadowband was developed by Michael J. Brooks at the University of KwaZulu-Natal (UKZN) in Durban, South Africa, to reduce the cost of providing widespread data for solar resource assessment and climate change. The shadowband consists of regularly spaced perforations, allowing alternate measurement of diffuse and global radiation throughout the day. A pyranometer equipped with the ZEBRA shadowband is used to independently measure diffuse and global irradiance. Clear sky direct irradiance may be calculated without relying on a moving shadowband or other instruments. With the aid of an absolute cavity radiometer, or other reference pyrheliometer, the ZEBRA can provide shade-unshade calibration for pyranometers. This project characterizes and investigates the accuracy of the ZEBRA shadowband for data acquisition and pyranometer calibration. Data from National Renewable Energy Laboratory (NREL) Solar Radiation Research Laboratory (SRRL) and UKZN was used to develop an algorithm to reconstruct global and diffuse clear sky profiles, test the shade-unshade pyranometer calibration method, derive and verify responsivity values, investigate thermal offset correction, calculate a shadowband correction factor, perform an uncertainty analysis, compare derived and reference data, study site dependence (using experimental results from southern and northern-hemisphere trials), and investigate performance under partly cloudy and overcast conditions. The combined statistical (2-sigma) and bias calculated uncertainty is about +/- 17 W/m^2 for diffuse irradiances and +/- 50 W/m^2 for global and direct irradiances. Comparisons of ZEBRA data with reference data have average empirical uncertainty of approximately +/- 30 W/m^2 or better for direct estimates, +/- 20 W/m^2 for global, and +/- 15 W/m^2 for diffuse. Our results demonstrate that the ZEBRA has the potential for use in mainstream radiation resource assessment as an alternative to multiple expensive instruments. The ZEBRA concept also has the potential to work for other types of radiometers. Further work may include the development of a software package for processing ZEBRA data as discussed here.

***Population Assessment of the New York State Threatened *Enneacanthus obesus* (Banded Sunfish) Conducted in Zeke's Pond and the Peconic River.** *Tyra Bunch, Carmen Maldonado* (*Southern University at New Orleans, New Orleans, LA*)*; Tim Green* (*Brookhaven National Laboratory, Upton, NY*). *Enneacanthus obesus* (Banded sunfish), the smallest species of sunfish inhabiting rivers, lakes, and ponds along the Atlantic coast, has been declared a threatened species in the state of New York. Approximately 200 sunfish were relocated to Zeke's Pond in 2004 during the remediation of the Peconic River, which runs through Brookhaven's property. However, in 2005 a drought nearly eliminated the relocated sunfish population. A population assessment was conducted in the Peconic River, and Zeke's pond, which is found on the eastern most point of Brookhaven's grounds. To capture and assess a sampling of the sunfish population, a seine net, a dip net, a bucket, a measuring tape, a pen, and an all weather writing tablet were utilized. The first step was to complete a survey of the aquatic vegetation by calculating the amount of vegetation in the immediate area that was to be seined. The sunfish were collected from the seine net, stored in the bucket, counted, measured, and then returned safely back to the water. No sunfish were found in the Peconic River. An area of approximately 25,785.5 ft.^{2} was covered in Zeke's Pond during a series of thirteen visits resulting in a total of eighty seines. Final fish counts yielded 369 sunfish, 66 catfish, and 13 pumpkinseeds. The estimated total population is 4,027, which is 4% of the previous study's count of 95,900.Further studies are necessary to document the life cycle and population trends of the Enneacanthus obesus.

***Effects on Soils after Burning Prairie Ecosystem.** *Paloma Martina Cuartero* (*Contra Costa College, San Pablo, CA*)*; Margaret Torn* (*Lawrence Berkeley National Laboratory, Berkley, CA*). Soil respiration is one of the many ways C is released in the atmosphere in form of CO_2. And since soils are the largest reservoir of carbon on land, where it accumulates roughly three times compared to that of the aboveground biomass and just about twice that of the atmosphere (Eswaran *et al.* 1993), the smallest change in soil carbon cycling worldwide can lead to major global climate change. Although fire is used to manage prairie ecosystem, wildfire is also a common event with effects on C balance that are not well understood. This study explains how burning affects C balance in the terrestrial ecosystem by comparing the C properties of burned and unburned soils. As expected, the C content of soil is much higher in the top surface soil where decomposition of organic matters occurs. Our data for the unburned soils shows C accumulates over time. However, burning prairie ecosystem allows C to escape from soils (in form of CO_2) causing a change of flux between the soil and the atmosphere. The total C lost is approximately 0.50 kg/m^2.

Exploration of a Real Options Analysis of the Nuclear Waste Issue. *Benjamin Dejonge* (*State University of New York at Brockport, Brockport, NY*); *David Lepoire* (*Argonne National Laboratory, Argonne, IL*). The question of how to assess energy criteria in a rapidly evolving world economy is nothing new, however it has recently captured more public attention due to changing political and environmental factors. For example, fossil burning power plants emit large amounts of greenhouse gasses. While all energy sources have pros and cons; for example, nuclear power has virtually no carbon emissions, but introduces problems in proliferation, waste (spent nuclear fuel — SNF), and accident issues, various research efforts and strategies have been proposed to reduce these problems. However, these research and environmental issues also require economical analyses to help determine the value of pursuing a particular technological path, such as the development and utilization of a closed-fuel cycle in which SNF is reprocessed and recycled to meet rapidly increasing energy demand while also potentially reducing risks. Real options analysis (ROA) addresses assessment in quickly changing situations with large uncertainties for actions that might be irreversible. ROA is applicable in determining the value of SNF reprocessing because the situation is one in which environmental assessments, technology, regulations, markets, and scientific understanding quickly evolve. An existing ROA based

discrete binomial lattice model on renewable energy was implemented in Microsoft Excel. The model was modified in order to better assess the value of SNF reprocessing with specific parameter values, nuclear growth assumptions, uranium price fluctuations, and various funding scenarios. A ROA value of about $9 billion was calculated, given that the initial price of uranium was 268 $/kg, with a government funding. This value indicates that with the simplified assumptions in this model it would be economically favorable to continue with consideration of reprocessing technologies. The sensitivity to the interest rate, the time to deploy, and the demand for nuclear fuel were investigated. Future work could address the inclusion of: more options (e.g., deploying in multiple phases), environmental costs (e.g., consideration of risk reduction), detailed data on potential plans, and modeling specific research efforts. Given the uncertainty in environmental, economic, and international politics, the U.S. is in a position to seriously consider reprocessing as a potential domestic and international energy source through the GNEP program. This technique could facilitate and communicate these decisions.

Effects of Naturally Occurring Ions on Arsenic Remediation in Bangladesh. *Emily Desley-Bloom* (*Contra Costa College, San Pablo, CA*); *Ashok Gadgil* (*Lawrence Berkeley National Laboratory, Berkley, CA*). Bangladeshis have been drinking arsenic contaminated water for over 20 years. Methods involving electrochemistry are being developed to improve the drinking water in Bangladesh. Few comprehensive studies have been performed on the naturally occurring ions found in Bangladesh, but a review of the available literature is essential to understand the potential effect such ions could have on remediation strategies employed in Bangladesh. In the following review, it was determined that phosphate had the greatest potential for interference, but it will not be a problem since the average concentration of phosphate in Bangladesh is less than was in the studies. However, in regions with high concentrations of these ions, an increased amount of iron hydroxides may be required to effectively remove arsenic from groundwater. The following report details the effects of various ions on arsenic removal via complexation with iron hydroxides.

Testing Vegetation Sampling Methods of Central Pine Barren Freshwater Wetlands in Preparation of the Wetland Protocol. *Emily Efstration* (*University of Delaware, Newark, DE*); *Ariana Breisch* (*Brookhaven National Laboratory, Upton, NY*). The current health of the freshwater wetlands of the Long Island Central Pine Barrens is unknown. In order to determine the health of the wetlands, a protocol must be established to determine a baseline. The baseline will then aid in monitoring future wetland conditions. Several bioassemblages of the wetland community will be examined because each element has an affect on the overall health of the wetland. Vegetation is an element that plays a major role in determining the health of the wetlands. It is the primary source of energy flow in the wetland ecosystem and forms the foundation of the wetland food chain. No other life forms are able to exist without the presence of vegetation. Plants, both dead and alive, form a structural habitat for many species to live and thrive in. Not only does vegetation affect taxonomic groups, but it also has a major impact on the wetland's water and soil quality. Therefore, vegetation is very important for the survival of the entire wetland community and must be closely monitored. By reading bioassessment case studies of Florida, Michigan, Minnesota, North Dakota, Oregon, Wisconsin and Maryland, different methods for analyzing wetland vegetation were collected and examined. Information on how to carry out various analytical techniques of vegetation was gathered and organized. The techniques that best suited our purpose, along with the necessary equipment, were taken into the Pine Barren Wetlands to be tested. Many different methods for analyzing the wetland vegetation was carried out in and around the wetland ponds of Long Island. The procedures that were the most practical and informative for the wetlands being assessed were noted. Many methods that were tested did not apply to the Pine Barren wetlands being examined because many of the case studies established permanent plots. Since the wetlands being studied will be on public lands, permanent plots were not a viable option. Upon investigating different methods of vegetative analysis, it was found that the case studies were very helpful, but many of the procedures were altered in order to accommodate the ponds being studied. Further investigation must be conducted in order to determine the precise vegetative methods that will be used to examine plants of the freshwater wetlands in the Long Island Pine Barrens.

Energy, Carbon and Climate: Projections to 2025. *Alison Erlenbach* (*University of Florida, Gainesville, FL*); *T.J. Blasing* (*Oak Ridge National Laboratory, Oak Ridge, TN*). Energy demands and associated carbon emissions in the U.S. are expected to increase in the foreseeable future. Policies to reduce fossil-fuel consumption and carbon emissions must consider present and future energy needs, and fuels available to most economically meet those needs, both of which show appreciable inter-regional differences. The National Energy Modeling System (NEMS), a product of the Energy Information Administration of the U.S. Department of Energy, projects this growth based on various economic factors for the country as a whole, and within each of the nine census divisions of the country. In this study, we summarized output from the NEMS for each census division, including projected regional carbon emissions which we calculated based on NEMS-projected energy statistics. To consider climate-change effects on energy demand, we used the results of an earlier study in which a Parallel Climate Model-Integrate BIosphere Simulator (PCM-IBIS) was used to drive the NEMS using different climate change scenarios. Base-case (no climate change) projections show varying increases in energy consumption and carbon emissions for each region, as their populations increase at varying rates. Carbon emissions do not increase proportionately to energy demands, but instead depend on the fuel types each region uses, and is projected to use, as well as the proportion of energy supplied by electricity. Electric generation is inherently an inefficient use of thermal energy; only about one-third of the thermal energy produced can be converted to electricity. The remainder is identified as "electricity-related loss" in the NEMS. Approximately 20% of U.S. carbon dioxide emissions result from this "lost" thermal energy. Effects of simulated climate warming, compared to the base case, were to decrease national energy demand. However, projected carbon emissions increased because reduced carbon from heating was outweighed by the increase in carbon emissions for electricity used for cooling. Regional carbon emissions increased at varying rates, being heavily dependent on the fraction of energy that is electricity and on the fuel types used to generate electricity. Policies to mitigate carbon emissions should consider regional differences in projected demands and in economically available fuels, as well as differences in regional potentials of renewable energy sources and of technologies that reduce wasted thermal energy.

Soil and Water Assessment Tool for a Population Viability Analysis of the Endangered Shortnose Sturgeon (*Acipenser brevirostrum*). *Kendall Ernst* (*Stanford University, Stanford, CA*); *Yetta Jager* (*Oak Ridge National Laboratory, Oak Ridge, TN*). The shortnose sturgeon is a federally endangered fish species found in the Ogeechee River System (ORS). Efforts are being made to ensure the persistence and support the expansion of the species; among these efforts is an increased awareness of the affect of land use on sturgeon habitat. The land use on and around the watersheds of a river have a direct impact on the water quality of the river, raising the question of how altering land uses will improve sturgeon chances of persistence. To answer this question, a Population Viability Analysis (PVA), in this case a computer model receiving inputs of water quality and hydrodynamics, will model individual sturgeon and provide information regarding extinction risk over an extended period of time. For the purpose of providing input, three models for the ORS will be implemented using the Water Quality Analysis Simulation Program (WASP), the Environmental Fluid Dynamics Code (EFDC), and the Soil and Water Assessment Tool (SWAT), which are respectively a water quality model, a river hydrodynamics model, and a watershed and water quality model. During the first year of the PVA project, the SWAT model has been most heavily emphasized because of its utility in discriminating among watershed influences on water quality. The EFDC and WASP models will be used later in the project when tidal variations will be considered within the ORS. SWAT requires several types of input to produce results. These are: land cover data, soils data, a digital elevation model (DEM), and stream flow lines. At this point in the project the model has been run, however, the model has not been calibrated. The process of calibration is as follows: the model is run with the current data, the results of the simulation are then compared to real data collected in the field, the input data is altered or upgraded, and the process is repeated until model output closely resembles real data. The ORS runs through a Fort Stewart military base as well as urban development and upstream agriculture. The goal of the model is to differentiate between the water quality contributions of the military base and urban land, as well as experimenting with the alteration of current land uses to see the effects on the water quality of the ORS, and then use each result in the PVA model. The model is part of a three year project, including the acquisition of several more datasets from the ORS through field work.

Effects of Climate Change on the Leaf Gene Expression of Avena barbata in a California Grassland Ecosystem. *Laleh Esmaili* (*Gavilan College, Gilroy, CA*); *Gary L. Andersen* (*Lawrence Berkeley National Laboratory, Berkley, CA*). Global climate changes

are impacting the environmental conditions of many ecosystems. In order to develop an informed understanding of the effects of climatic changes on a grassland ecosystem, a study was conducted to examine plant response to altered rainfall pattern and increase nitrogen availability. *Avena barbata*, an abundant species in many Californian annual grasslands, was grown on natural soil in a climate-controlled greenhouse and submitted to three precipitation treatments (low, ambient and high rainfall) and two levels of nitrogen (ambient and addition of NH_4NO_3). The transcript abundance of three genes of interest (RbcS, GS1 and GS2) was studied in leaf samples collected from *A. barbata* plants at peak physiology. The changes in rainfall patterns did not have a significant effect on the total RNA content from *A. barbata* leaves or leaf gene expression except for GS1. Fertilization of the ambient soil conditions with NH_4NO_3 significantly increased the leaf RNA content and also lead to increased transcript levels for RbcS and GS2. The results suggest that *A. barbata* plants grown under high nitrogen availability respond by changing their gene expression possibly to increase the rate of photosynthesis and growth. This data will be used together with biochemistry and physiology data in a model to predict ecosystem response to climate change.

Relationship Between Water Flowpaths, Water Content, and Particle Size in Partially-Saturated Sediment Samples. *Luxi Fang* (*Furman University, Greenville, SC*)*; Melanie Mayes* (*Oak Ridge National Laboratory, Oak Ridge, TN*). The transport and fate of nuclear processing wastes in unsaturated sediments at U.S. Department of Energy's Hanford Site in Richland, WA is of concern due to the proximity of the Columbia River. Intact cores (0.2 m x 0.2 m) were collected to study the effect of sedimentary layering on the hydrologic and geochemical processes controlling contaminant transport. The goal of this project was to study the relationship between water content, particle size, and flowpaths in the cores as inferred using a dye tracer (Brilliant Blue FCF). The dyes are predicted to follow the water flowpaths and to be found in the most conductive flowpaths. Kinetic studies determined the rate of dye interaction with two types of soil samples, Hanford Coarse (HC) and Hanford Dike (HD). We used dye concentrations of up to 5g/L and set them for different equilibration time periods. An isotherm batch study was performed in order to determine the distribution of dye among sediment and solution at different concentrations. Solution samples were analyzed using UV-visible wavelength spectrophotometry in order to quantify dye concentrations. This data was plugged into the convective-dispersive equation to predict the transport of dye through the intact cores and to determine when to dissect the core. We prepared a dye tracer for the dissection of HC and HD cores at the highest concentration (5g/L). We dissembled the cores before any dye was visible in the effluent. The cores were dissected into approximately 9 horizontal layers at 5 different depths, while photographing the appearance of the dye. We found the mass wetness of each sample. Since HD and HC are horizontally-oriented cores where the beds are parallel to the direction of flow, we determined particle size analysis across cores at one depth. The water content and particle size were related to water flow paths as inferred by the presence of the dye. The distribution of dye showed significant preferential water flow and solute transport for both samples, even though HC sample appeared to be homogeneous. For the HD sample that consisted of distinct sand and clay layers, the transport was controlled by visible layering. A relationship between moisture content and preferential flowpaths was found for HC. The finding suggests that the transport of the contaminants in the unsaturated Hanford sediments may be mainly controlled by water content and particle size.

***Vertical Transport in the Urban Atmospheric Dispersion Test.** *Ramon Fernandez* (*State University of New York at Stony Brook, Stony Brook, NY*)*; John Heiser* (*Brookhaven National Laboratory, Upton, NY*). Part of the Urban Dispersion Program (UDP) is to investigate the behavior of vertical transport of gases around the rooftop of buildings of New York City (NYC). The research emphasis of the vertical transport component focuses on how the regional winds affect the movement and distribution of tracers along NYC's rooftop buildings. To carry out the project, Brookhaven National Laboratory scientists and environmental engineers released six different perfluorocarbon tracers, which are non-toxic harmless gases and have a range sensitivity up to parts per quadrillion (10–15). Air samplers were placed on NYC's rooftops during six intensive operating periods (IOPs) of the field project, which took place during February, 2005. These IOPs generally ran from 7 am until 2 pm of that same day. Data were collected and analyzed to validate tracer movement patterns by comparing the ground level tracer concentrations to the rooftops tracer concentration. As part of the validation process, we compared tracer concentrations as a function of time and distance. We have used tracers that have similar transport characteristics so that as they follow each other we can have a 3-D model validation.

***Poor litter quality under elevated atmospheric carbon dioxide concentrations reduces aquatic macroinvertebrate colonization of decomposing leaf litter in streams.** *Vanessa Garcia* (*California State University – Fresno, Fresno, CA*)*; Aimee T. Classen* (*Oak Ridge National Laboratory, Oak Ridge, TN*). Levels of atmospheric CO_2 have increased since the industrial revolution and are expected to continue to rise. Previous work has shown that leaf litter produced by trees grown under elevated levels of atmospheric CO_2 is of lower quality (increased carbon (C) to nitrogen (N) ratios) relative to leaves grown under ambient CO_2 levels. While many studies have focused on how this change in quality may alter terrestrial decomposition, few have investigated how it may alter invertebrate decomposition of leaves in streams. Our objective was to determine whether a decline in leaf litter quality (i.e, an in increase in litter C:N) due to elevated atmospheric [CO_2] would decrease the number of invertebrates that fed on leaf litter in streams. Leaf litter used in this experiment was collected from the Oak Ridge National Laboratory (ORNL) Free Air Carbon Enrichment (FACE) site in early September, 2006 after leaf senescence. Leaf litter from each ring was combined by treatment (ambient or elevated) and placed into mesh decomposition bags. Bags were submerged in a first order stream on the Oak Ridge reservation and removed at five different time periods between January and May 2007. Upon returning to the laboratory, samples were processed to remove litter invertebrates. Results indicate that, over time, there are less aquatic invertebrates on leaves grown under elevated atmospheric [CO_2]. These results suggest that stream macroinvertebrates prefer to colonize and feed on leaf litter of higher quality (i.e., litter grown under ambient CO_2 conditions).

A GIS Mapping Inventory of New York's Lake Ontario Ordnance Works for the Benefit of Environmental Decision Making. *Kyla Gregoire* (*Florida State University, Tallahassee, FL*); *Lisa Durham* (*Argonne National Laboratory, Argonne, IL*). Lake Ontario Ordinance Works (LOOW) of Niagara County, New York was, in 1942, home to a trinitrotoluene (TNT) production plant. From 1944 to the early 1950s, the Manhattan Engineering District (MED) used the site to store radioactive residue from the processing of uranium ore. Current remediation efforts, which began in 1970, focus on the implementation of risk-based environmental assessment (RBES) to determine future land use and appropriate clean-up criteria. Discontinuities in technology and the level of detail among the 50 years of LOOW documentation often make it difficult to use and combine the various historical maps, photos, and documents. Such discontinuities can impede the decision-making process for site remediation and closure. To eliminate this remediation obstacle, the ESRI Arc Geographic Information Systems (ArcGIS) program was employed to catalog historic, spatial layers relating to the site. All historic, hard-copy physical map layers such as parcel boundaries, utility lines, and structures were first cataloged in Excel spreadsheets. They were subsequently cross-referenced to the available layers of the electronic record. In this manner, the final GIS inventory will be compiled as a complete replica of the original, hard copy, historic record. Attention was paid to detail such as uniform coordinate systems and the evolution of site layers over 50 years, which ensures consistency and readability among maps. The end product will be a GIS dataset of physical, hydrologic, and ecologic maps related to the site and surrounding area. This product will aid in determining clean-up criteria for the LOOW site media, comparing remedial alternatives, and ultimately designing remediation and site closure strategies. Further, it will communicate remedial efforts and progress among all LOOW stakeholders. Similar GIS cataloging techniques could be employed for remedial decision-making and environmental communication of contaminated sites nationally and globally.

Testing of Nanoporous Niobium Thiophosphates for the Removal of Heavy Metals from Water and Waste Streams. *Kyla Gregoire* (*Florida State University, Tallahassee, FL*)*; Dawn Wellman* (*Pacific Northwest National Laboratory, Richland, WA*). Current methods of offshore oil drilling and coal energy production result in waste streams with elevated levels of toxic metals including mercury, lead and cadmium. The ability to efficiently remove these metals from production waters would reduce the risk of bioaccumulation in humans and wildlife. Recent advances in the field of nanotechnology indicate that nanoporous metals are effective sorbents for removing contaminants from aqueous solutions. In this investigation we present the development of nanoporous niobium thiophosphate (NP-NbTPO), and the results of static batch sorption tests to quantify the ability of nanoporous thiophosphates to sequester mercury, lead and cadmium from aqueous solutions. Results demonstrate that nanoporous niobium

thiophosphate materials provide a loading capacity of ~700 mg/g for mercury and Kd values 1.28 x 10^6 mL/g for lead and 1.54 x 10^5 mL/g for cadmium.

Elevated Atmospheric [CO_2] Concentrations Do Not Alter Net Nitrogen Mineralization Rates in a [CO_2] Enriched Sweetgum Forest. *Caitlin Guthrie* (*Pomona College, Claremont, CA*); *Aimee T. Classen* (*Oak Ridge National Laboratory, Oak Ridge, TN*). Carbon dioxide concentrations ([CO_2]) in the atmosphere have increased by 36% in the last 250 years. Previous research has demonstrated that elevated levels of atmospheric [CO_2] can increase plant production. However, to maintain an increased level of growth, trees must acquire higher levels of soil nutrients. Thus, nutrient availability might ultimately constrain the response of forests to elevated [CO_2]. In particular, nitrogen (N) often limits plant production in terrestrial ecosystems, and understanding how soil N cycling responds to elevated [CO_2] in forests will enable scientists to make better predictions of how forests will respond to climatic changes in the future. I took advantage of a long-term experiment at Oak Ridge National Laboratory (ORNL) manipulating atmospheric [CO_2] to test the prediction that elevated [CO_2] would decrease net N mineralization. Net N mineralization is the amount of N that microbes have transformed from an organic form to an inorganic form that is available to plants (minus the N taken up for use in microbial biosynthesis). The ORNL, Free-Air [CO_2] Enrichment (FACE) facility was constructed on a sweetgum plantation planted in 1988. There are five 25-m rings (two elevated rings where the target concentration is 550 ppm CO_2, and three ambient rings) and the treatments have been running since 1998. I inserted N mineralization soil cores into each of the rings in June and July, 2007, and let them incubate for 30 days each. Results indicate that there is no difference in net N mineralization rates, net N nitrification rates, or leaching between elevated and ambient plots. However, there was a significant decrease in net N mineralization rates for both treatments from June to July. These results may indicate that increased forest production under elevated [CO_2] has not altered the net amount of N available for tree uptake at ORNL FACE. Alternatively, the lack of response to elevated [CO_2], and concurrent temporal response could reflect the low levels of precipitation (the third lowest on record since 1895) observed over the course of this study. More work is needed to illuminate the effects of elevated [CO_2] on soil N cycling and its effects on forest production at this site.

Estimating Evaporative Transpiration in Wetlands of the San Joaquin Valley. *Adam Hall* (*Bowdoin College, Brunswick, ME*); *Nigel Quinn* (*Lawrence Berkeley National Laboratory, Berkley, CA*). Since the water resources of Central California are intensively used in agricultural and municipal contexts water resources available for managed wetlands are very limited and must be carefully managed. Modeling patterns of evaporation and transpiration, collectively referred to as ET, is an important step in managing irrigation regimes with the goals of limiting evapo-concentration of salts and maintaining high levels of water quality with the greatest possible water use efficiency. In agricultural systems water needs are often estimated by reference to potential ET (ETo) values, the ET of a well watered pasture plot. ETo data is readily available from weather stations reporting to the California Irrigation Management Information System from locations throughout the state. The relationship between ET and ETo in agricultural systems is well understood. This relationship is less well understood for wetlands because of the complex vegetation and moisture dynamics within these systems. A Bowen Ratio Energy Balance Station was deployed to a wetland near Los Banos to estimate ET using a Bowen Ratio Energy Balance Equation. Micro-meteorological sensors measure incoming and outgoing energy fluxes through air and soil and estimate the latent heat flux of the system, which is proportional to ET. Our estimates of ET are compared to ETo values reported to the CIMIS network. Wetland ET and ETo values do not correlate well. The dynamic nature of wetland plant communities and water resources create more complex patterns of ET than those observed at ETo plots where water resources and plant communities are intentionally held constant. Modeling of wetland ET based on ETo data will must account for seasonal changes in soil moisture and plant community composition and distribution. This research contributes to a larger project of understanding the relationships between irrigation timing, water use, water quality, and plant communities. A variety of methods, including soil salinity surveys and remote sensing estimates of plant community distributions will be integrated to model wetland moisture and plant community dynamics with the aim of improving wetland best management practices and water use efficiency while sustaining valuable wetland habitat.

Linking Microbial Diversity and Geochemistry of Uranium-Contaminated Groundwater. *Danielle Hall* (*University of Michigan – Dearborn, Dearborn, MI*); *Christopher Schadt* (*Oak Ridge National Laboratory, Oak Ridge, TN*). Microbes control many of the important geochemical processes that occur in the environment. They utilize and produce nutrients that are involved in eutrophication and are even capable of cleansing the environment by degrading a vast variety of chemical compounds. In this study, microbial communities were assessed based on clone libraries of 16S rDNA genes from the Department of Energy Field Research Center. The samples were collected from four different sites (GW-835, GW-836, FW-113-47, and FW-215-49) containing varying levels of pH (3 to 7), nitrate (44 to 23,400 mg/l-1) and uranium (0.73 to 60.36 mg/l-1). Community DNA was extracted by grinding the samples with sterile sand and liquid nitrogen. The resulting DNA was purified then amplified using polymerase chain reaction (PCR) with 16S ribosomal primers. The 16S ribosomal genes were cloned using a PCR 2.1 vector and then transformed in *E. coli* cells. The clones were then screened by PCR and sequenced. The sequence data were analyzed for each clone library using BioEdit, DOTUR, LIBSHUFF, and RDP Classifier. Results indicated that bacterial diversity correlated with the geochemistry of groundwater. Bacterial diversity was highest at the site with a neutral pH and containing the lowest concentrations of nitrate and uranium (GW-836). The diversity decreased with declining pH values and increasing concentrations of nitrate and uranium. This difference reflects not only the diversity measurements and indices of nucleotide sequences but also LIBSHUFF analysis of clone libraries. The clones consisted primarily of sequences closely related to the phylum Proteobacteria, with site FW-113-47 almost exclusively containing this phylum. Firmicutes, Bacteroidetes, and Chloroflexi were also very prevalent bacterial groups in all samples except FW-113-47. The microbial community information gained from this study and previous studies at the site can be used to develop predictive multivariate and Geographical Information System (GIS) based models for microbial populations at the FRC. This will allow for better understanding of what organisms are likely to occur where and when based on geochemistry, and how these relate to bioremediation processes at the site.

***Studying the Soil of an Intentionally Burned Field to Understand More about the Effects of Wildfires and Climate Change on the Carbon.** *Alfredo Hernandez* (*Contra Costa College, San Pablo, CA*); *Margaret Torn* (*Lawrence Berkeley National Laboratory, Berkley, CA*). To learn more about the amount of carbon and nitrogen in 20 different plots taken in El Reno, Oklahoma, and to understand more about the carbon cycle and the involvement of wildfires, especially in the prairie fields of Oklahoma, different cores were taken from the fields and studied by depth. Comparison of carbon to nitrogen ratios of burned and unburned surface soil was one way to approach this question. Since carbon to nitrogen ratios are important for plants and microorganisms in soil, the amount of carbon and nitrogen with depth was also important. The results showed no significant difference in the carbon to nitrogen ratio in comparison of burned and unburned field. The ratio is also similar as you go down with depth in co with depth in comparing all the cores.

Elevated Atmospheric Carbon Dioxide Effects on Agricultural Soil Carbon Using Free-Air Concentration Enrichment. *Liz Hofreiter* (*Bradley University, Peoria, IL*); *Julie D. Jastrow* (*Argonne National Laboratory, Argonne, IL*). Increasing atmospheric carbon dioxide (CO_2) has raised concerns that global climate change will result in adverse consequences including a loss of ecosystem biodiversity. In attempts to offset rising CO_2 levels, carbon (C) sequestration potential in agricultural ecosystems is being examined to determine if agricultural soil will act as a sink for future C emissions. This study examined the effects of CO_2 enrichment on soil C storage in maize (Zea maize L.) and soybean (Glycine max L.) rotation agro-ecosystems in Champaign, Illinois over a seven year period. Free air concentration enrichment was used to elevate CO_2 in four crop rings 70 m in diameter. An identical set-up was established for an additional four control rings held at normal atmospheric CO_2 levels. Core samples 25 cm deep were collected from all eight rings and fractionated into particulate organic matter (POM), microaggregates >53 µm, silt, and clay. Microaggregates >53 µm were further fractionated, isolating intra-aggregate POM, silt, and clay. Fractions were dried and processed through the Carlo Erba to find percent C by gas chromatography. The C distribution dropped in all soil fractions in both control and elevated rings by less than 2 mg C/g soil between 2001 (when pre-experiment samples were taken) and 2007. Percent carbon also decreased in all soil rings (control and elevated) ranging from -0.0736% to -0.9905%, with the exception of

ring five (elevated) which increased by 0.0339%. The nominal change of C can be attributed to slow soil organic matter accretion. Although past studies show increases in root biomass in elevated CO_2 rings, only a fraction of C in root biomass is translated to soil organic carbon, resulting in a slight accumulation of soil C, which may take more than 7–10 years to detect. A greater time period is needed before future studies are conducted to compare soil C accumulation to initial 2001 values.

Air Quality Impacts of Gas Appliance Usage. *Trang Huynh* (*DePaul University, Chicago, IL*); *Brett Singer* (*Lawrence Berkeley National Laboratory, Berkley, CA*). Liquefied natural gas (LNG) from the Pacific Rim is being considered for use in Californian homes to supplement domestic natural gas supplies. Because the composition of natural gas varies depending on the origin of the gas supplies and the process of purification used by gas companies, studies are being performed to determine if this new source of natural gas can be introduced safely and efficiently into Californian homes. To determine the health and environmental impacts of LNG, NO_x, CO_2, and CO and fine particle concentrations (below 1 $x10^7$ particles/cm^3) were collected through an exhaust hood and measured using gas and particle analyzers during gas appliance usage. Before LNG fuel sources can be tested, it is necessary to develop a method for determining conditions for optimal appliance performance and minimal particle emissions during appliance usage using current natural gas supplies to compare with future experiments with LNG. Currently, studies are being performed to determine the effect of cleaning ovens on the amount of particles that form during oven usage. The concentration of particles measured during oven usage varied (approximately $1x10^7$ to 1 $x10^4$ particles/cm^3) by oven temperature setting and by oven model. Following cleaning, oven particle concentrations decreased by an order of magnitude. These results will be used to develop a standardized method of conditioning appliances and to study gas appliance performance in a range of conditions to compare with future experimental studies using LNG.

Heterogeneity of Aquifer Materials and Spatial Variability in the Carbon Tetrachloride Plume in the 200-West Area, Hanford Site. *Tamara Jeppson* (*Utah State University, Logan, UT*); *George V. Last* (*Pacific Northwest National Laboratory, Richland, WA*). The migration and transformation of groundwater contamination is affected by the physical and chemical heterogeneity of the lithofacies that make up aquifer material. At the 200 West area of Washington State's Hanford Site a plume of carbon tetrachloride (CCl_4) is located in the unconfined aquifer. Remediation of the plume requires accurate models of the subsurface that show the lithofacies and their affect on the migration of CCl_4 in the aquifer. To add detail to previous models a 2.87 km long transect along the eastern part of the 200 West area was chosen. The transect passes through eight wells; the borehole and geophysical logs from these wells were standardize and interpreted to create a geologic cross section showing the depth and continuity of the lithofacies. Depth discrete measurements of the concentration of CCl_4 and chloroform ($CHCl_3$), which forms as a result of the dechlorination of CCl_4, were used to infer the extent of the contaminant plume. The high concentrations of $CHCl_3$ occur in the same areas of the cross section as the high concentrations of CCl_4, their correlation suggests that geochemical reactions maybe causing the dechlorination of the CCl_4. A comparison of the contaminant concentrations and stratigraphy shows that the highest concentrations of the CCl_4 and $CHCl_3$ occur around and are confined by fine grained layers. Within the fine-grained layers the concentration of $CHCl_3$ is higher than it is outside of the layer indicating that reduced zones and iron-containing sediments, needed for the dechlorination of CCl_4, may be present in high amounts in these layers. In the southwest end of the cross section there are high concentrations of CCl_4 and $CHCl_3$ that apparently do not occur near a fine grained layer. This difference implies that there maybe reduced, iron-containing sediments within the coarse-grained layers as well as the fine-grained layers The influence of reduced zones and fine-grained layers on the contaminant plume indicates that improved understanding of the spatial variability of these reactions should improve fate and transport predictions and lead to better remediation decisions.

***Long Island's Interactive Weather Map and Microsoft Excel Data Entry.** *Katie Johnson* (*St. Joseph's College, Patchogue, NY*); *Joe Lanier* (*State University of New York at Stony Brook, Stony Brook, NY*); *Victor Cassella* (*Brookhaven National Laboratory, Upton, NY*). The Long Island Interactive Weather Map was created for all personnel on site at Brookhaven National Laboratory (BNL). The primary purpose of this map is to give employees a place where they can access current weather data from all over Long Island, as well as archival data dating back from the 1940s up to the present day. Throughout weather stations across Long Island, we collected data on temperature, wind speed, direction, gusts, barometric pressure, humidity, and precipitation from old records and entered them into a large Microsoft Excel database. This data is sent via radio waves to a receiver at BNL, collected and stored as an ASCII string, fed into a MySQL database, and updated on the meteorological website once a minute. We have created a web page using the following languages: PHP, SQL, JavaScript, and HTML. This page has an image of Long Island and displays all of the towns with BNL's current weather stations. When a user hovers over any of the towns or stations, a small pop-up box appears and the current data is displayed for that town. At the bottom of the box, a link for further archive data is available for that town or station. The user can navigate through the data to get what is needed. Never before has there been such an easy, all-in-one design that has allowed users to see current and archival weather data on BNL's meteorological website. Throughout this project, the majority of the BNL weather acquisition system has been reconfigured and available to the BNL staff.

Improving Efficiency of Storage Gas Water Heaters. *Derek King* (*Laney College, Oakland, CA*); *Jim Lutz* (*Lawrence Berkeley National Laboratory, Berkley, CA*). The energy required for water heating accounts for approximately 25% of national residential natural gas consumption. In California that figure is closer to 40%. With water heating using such a substantial portion of valuable natural gas resources, water heating appliance efficiencies deserve some scrutiny. What is referred to as "standby losses" are addressed in this study. Typical storage gas water heaters have a flue for combustion exhaust located along the center of the storage tank. When the burner is inactive, ambient air flows through the flue. The cooler air absorbs heat from the storage tank and rises out of the exhaust vent. Fresh air is drawn in through openings at the base of the heater. This cycle continues until the stored water falls below the preset maintenance temperature and the burner is activated. Consequently, more fuel must be spent to maintain a store of hot water to keep up with the standby losses. Several alternative designs have been proposed to address this energy loss mechanism and remain competitively priced for consumers. The Department of Energy's 24 hour efficiency test will be used to compare performance of an off-the-shelf storage gas water heater and the alternative prototypes. The prototypes that demonstrate an improvement in heating efficiency could then be further developed for the consumer market.

The Application of Surface Enhanced Raman Scattering (SERS) to Pollen Identification. *Bradley Landgraf* (*Allegheny College, Meadville, PA*); *Meng-Dawn Cheng* (*Oak Ridge National Laboratory, Oak Ridge, TN*). The current method of pollen identification — collecting pollen grains on filters, examining each grain with a microscope, and comparing the grain with a reference — is a timely and tedious process in need of modernization. Raman spectroscopy can be used to identify pollen species, but this method suffers from a low signal strength that can make identification difficult. To address this low signal, a technique known as Surface Enhanced Raman Scattering (SERS) was developed. SERS involves the adsorption of nanometallic particles or surfaces (silver, gold, or copper) to analyte molecules. While SERS has been used to identify a number of biomolecules, little work has implemented SERS in pollen identification. Accordingly, this study focused on finding a synthesis and adsorption method that yielded the most effective signal enhancing silver nanoparticles. The syntheses involved the reduction of silver nitrate ($AgNO_3$) with either sodium citrate ($Na_3C_6H_5O_7$) or sodium borohydride ($NaBH_4$) to yield elemental silver (Ag_0) nanoparticles. Several techniques were used to adsorb the nanoparticles to the pollen grains, such as air-drying and aerosolization. The pollen grains of interest were from three species of plants — common ragweed (*Ambrosia artemisiifolia*), eastern white pine (*Pinus strobus*), and smooth tag alder (*Alnus incana ssp. rugosa*) — indigenous to the eastern U.S. and known for their allergenicity. Spectra for each pollen species were obtained and compared to Raman spectra taken without SERS to see which synthesis and adsorption method provided the best Raman signal enhancement. The $NaBH_4$-synthesized silver applied by aerosolization produced the best spectra by eliminating some of the background noise associated with Raman spectroscopy, however, no significant enhancement occurred with either synthesis. Aerosolizing the silver colloid was the most effective application method, as all other means of application caused too much silver to be adsorbed to the pollen grains. Future research involving alternative silver nanoparticles syntheses, whether or not gold or copper may be more effective, and the mechanization of aerosol application to the pollen should be completed, as SERS is a technique that could

play an integral role in developing an analytical instrument capable of identifying pollen grains *in situ* and in real time.

***Redesign of the Personal Air Sample (PAS).** *Miguel Lopez* (*State University of New York at Stony Brook, Stony Brook, NY*); *Damoon Moin* (*Sacramento City College, Sacramento, CA*); *John Heiser* (*Brookhaven National Laboratory, Upton, NY*). The Personal Air Sampler (PAS), a versatile air-sampling instrument used to identify many chemical particulates, is used at Brookhaven National Lab (BNL) to capture Perflurocarbon Tracer Samples (PFT). PFTs, along with the PAS, are used for personal dose assessment studies, atmospheric dispersion studies and nuclear control room infiltration measurements. The first PAS was a pocket-sized air sampling unit which held a Capillary Adsorbent Tracer Sampler (CATS) tube for sampling tracers. The pump flow rate for the older unit was set via a variable resistor and using an external flow meter. In the field the pump flow rate proved to be unstable and varied greatly. This instability in the flow rate resulted in the air volume sampled being highly varied from sample to sample. A secondary tracer analysis was required to determine the sample volume and this result in much greater analytical expense, time delays and greater uncertainties in the data. A new design for the PAS was developed that allows control of the pump flow rate via mass flow determination. In addition to the mass flow measurement component, the new PAS uses a programmable micro-computer (ATMEGA128L) to control the pump speed, allow programmability of flow rate, sample time, data logging and to display the PAS parameters (pump flow rate, battery power, and temperature inside the unit) on a liquid crystal display. Programming is accomplished using a personal computer and a mini-USB interface connection. One additional feature of the new PAS is a sensor that tells the main computer when the CATS is inserted or removed. We are in the process of building and testing these new devices. The new design will allow us to get more accurate data with better QA/QC management and are a major upgrade to the old units.

Analysis of Meteorological Observations Over the Former USSR, 1950–2000. *Garrett Marino* (*Massachusetts Institute of Technology, Cambridge, MA*); *Dale P. Kaiser* (*Oak Ridge National Laboratory, Oak Ridge, TN*). Climate change studies require the processing and analysis of large compilations of meteorological data. Past studies investigated trends in meteorological variables over the former Soviet Union using data from a 223-station network spanning 1936–1990. A newly-acquired update to the database includes data through 2000. The database has been made available through cooperation between the two principal climate data centers of the United States and the former Soviet Union: the National Climatic Data Center, in Asheville, North Carolina and the All-Russian Research Institute of Hydrometeorological Information — World Data Centre in Obninsk, Russia. Station records consist of 6- and 3-hourly observations of 25 meteorological variables including temperature, precipitation, cloud amount and type, pressure, humidity, and wind speed and direction. The 6-hourly observations extend from 1936 through 1965; 3-hourly observations extend from 1966 through 2000. To ensure high data quality, extensive quality assurance (QA) checks examined the data for completeness, reasonableness, and accuracy. We found significant gaps in some records from observational gaps or measurement values deemed erroneous. Also, World War II and the breakup of the Soviet Union affected some records' completeness. Therefore, this analysis examined the period 1950–2000 for 125 stations. Total and low cloud amount, frequencies of various cloud types, and air temperature were all extracted from the dataset and plotted by station to assess variability and any long-term trends. The results showed that trends found by previous researchers using data through 1990 have continued through 2000. Total cloud cover significantly increased (95% confidence level) at 0.2%/decade despite a significant decrease in low cloud cover of 1.1%/dec. Meanwhile, low level stratiform clouds significantly decreased by 1.6%/dec and cumulus clouds significantly increased at 1.4%/dec. Stratiform clouds are associated with atmospheric stability and frontal passages. A warmer planet and the resultant reduction of both the meridional temperature gradient and atmospheric stability may be causing these cloud trends. Air temperature did exhibit a significant increase of 0.2°C/dec. The Russian database represents a wealth of meteorological information for a large and climatologically important portion of the earth's land area, and should prove useful for a wide variety of additional regional climate change studies.

Sediment Phosphate Desorption Kinetics. *Jolene Mattson* (*Laney College, Oakland, CA*); *Willliam Stringfellow* (*Lawrence Berkeley National Laboratory, Berkley, CA*). Phosphate, as a main component in fertilizer, is heavily used in the Central Valley farmlands of California. Phosphate can negatively impact aquatic ecosystems such as the San Joaquin River (SJR), by stimulating elevated algal growth. This study sought to determine if suspended and bed sediments could act as a significant source of phosphate to the SJR watershed. It was hypothesized that agriculturally derived sediments would have high desorption rates, and reach equilibrium in 24 hours. Rapid equilibrium is required for sediment to act as nutrient reservoirs for algae growth since algae grow with a doubling time of less than 24 hours in the SJR. Sediment samples were collected from two sources: Ramona Lake, an open surface freshwater wetland which receives agricultural sediment, and the San Luis Drain (SLD), a major drainage for irrigation runoff in the SJR valley. Two studies were conducted examining desorption of phosphate from these sediments in simplified water-sediment flux environmental models. Water samples were collected, filtered, and analyzed according to the Ascorbic Acid method using a UV/VIS spectrometer. Sediment mass desorption rates under mixed, aerobic conditions indicative of suspended sediments, were not rapid, 39.4 and 16.0<μ>g PO_4-P/kg dry sed/hour for Ramona Lake and SLD respectively. The time required to reach equilibrium was longer than the hypothesized length of 24 hours. At high sediment water ratios equilibrium was not reached until after 400 hours. In an attempt to reach equilibrium more rapidly, the second aerobic experiment was run with sediments at lower concentrations, and aqueous phosphate concentrations reached equilibrium with sediments only after 250 hours. Ramona Lake sediments again showed a faster average mass desorption rate than SLD sediments, with averages being 54.3 and 10.3<μ>g PO_4-P/kg dry sed/hour respectively. The differences between sediment mass desorption rates could be variation of total phosphate and organic carbon contained in the two sediments and are under investigation. Under anoxic, layered conditions, indicative of bed sediments, Ramona Lake sediments had good initial desorption reproducibility. Initial area desorption rates showed significant desorption of phosphate, averaging 19.8mg PO_4-P/m^2hour. Results of this study indicate that sediments serve as a reservoir for phosphate, but rates of desorption are lower than expected, and will not support exponential algal growth at high biomass densities.

Educating Communities of Industrial Contaminants and Health Effects. *Margaret McKie* (*Loyola College in Maryland, Baltimore, MD*); *Margaret MacDonell* (*Argonne National Laboratory, Argonne, IL*). An overall project of educating communities on safe contaminant levels and health effects concerning these contaminants is being realized through two different applications. The Research Institute of Industrial Science and Technology (RIST) in South Korea has requested the occupational and health-related toxicity values and key health effects of a list of more than 50 contaminants released into the air during the steel making process, to compare with the current output of these chemicals from a local steel company. Toxicity values from governmental and other scientific agencies were compiled into tables. These tables will serve as a foundation for a database for the communities, making them easily accessible by the responsible industry managers and the community, and other agencies in the future. The toxicity values will give the company a mark to measure their own values against, to see if they are within a safe range and to prioritize their future pollution mitigation plans. Another application of this project that puts knowledge of toxicity values into use concerns mercury and other chemicals used in the gold mining process. The purpose of this project is to educate gold shop owners and local artisans of the dangers when working with mercury and cyanide when producing gold. A prototype of a website was started to get the information to local people via teachers and trainers. The goal of this program is to develop health based information and facilitate training through easy to understand lessons. Outlines of chemical fact sheets that address mercury and cyanide have been created so that employers and the community can have a quick reference for the health effects of these chemicals. Nearly 20 resources used to create the fact sheets and website were put into a matrix delineating the most prominent topic and key content, so readers can navigate through the literature more easily. A business plan was outlined in order to support the wider use of mercury retorts to reduce airborne releases throughout the world of small gold mining. Through the education of workers and employers the Environmental Protection Agency hopes to create a safer working and living environment in these regions. Both applications have similar goals which are to notify communities of the toxicity and possible health effects of contaminants in the air and water, so educated decisions concerning health and the environment can be made.

***Measurement of Aerosol Absorption Using Photothermal Interferometry: Folded Jamin Interferometer.** *William McMahon* (*SCCC, Selden, NY*); *Arthur Sedlacek* (*Brookhaven National*

Laboratory, Upton, NY). While the role of greenhouse gases (GHG) on global climate change is well understood the contribution of aerosols to climate change is much more uncertain. For example, depending upon their optical properties, aerosols can either offset GHG effects (through scattering) or contribute to global warming (through absorption). As a result, there is a need for improved measurements that will better quantify the role of aerosols on our climate. The Photothermal Interferometer (PTI) is an instrument designed to measure aerosol absorption. In its present configuration the PTI measures aerosol absorption at one wavelength incorporating a Lock-In Amplifier in a Phase Sensitive Detection (PSD) technique. However, climate modelers require aerosol absorption data at several wavelengths, in which case an LIA would need to be dedicated to each wavelength. To meet this requirement upgrades to the control and data acquisition system of the PTI unit must be made. Specifically, using an Analog to Digital Converter (ADC) card combined with the Fast Fourier Transform (FFT) technique several wavelengths can be separated and analyzed simultaneously. This FFT technique would replace the PSD technique eliminating the need for multiple LIA's. Preliminary measurements verified 1) A strong correlation between the LIA and FFT techniques, and 2) The linear response of PTI signal to concentration of absorbing gas.

Just in Time Data Retrieval Using Python. *Elvira Meza* (*City University of Seattle, Bellevue, WA*); *Lance Vail* (*Pacific Northwest National Laboratory, Richland, WA*). Vail and Skaggs (2002) describe the conceptual design of a system to improve natural resources management in the Columbia River Basin. A key feature of this proposed system is the need to access data from distributed servers on a "just in time" basis. This capability is essential to ensure that the system's ability to fulfill the system's requirements related to accountability, accessibility, and adaptability are achieved. The system is composed of toolboxes related to decision support, model management, and data management. The functionality of the data management toolbox requires a reliable and flexible capability to for distributed data management. The project described herein was to evaluate the utility of the Python programming language to develop tools for a wide range of platforms that can perform the "just in time" data access and filtering.

Simulating Land Competition for Biomass Energy, Forestry and Agriculture:G-FALUM, Global Forestry and Agricultural Land Use Model. *Zheng Mi* (*Colorado College, Colorado Springs, CO*); *Anthony King* (*Oak Ridge National Laboratory, Oak Ridge, TN*). This research addresses the competition for land to simultaneously satisfy growing biomass energy, forestry and agricultural demands as part of sustainable energy and carbon management strategies within the context of CarMan, a global carbon management analysis model. A review of existing land use models (FASOM, AgLU and KLUM) identified insufficiencies for addressing biomass energy land-use in CarMan. In response we developed a new Global Forestry and Agricultural Land-Use Model, G-FALUM. G-FALUM is designed to simulate the competition for land from biomass energy, forestry and agricultural production over a period of 100 years. Numerical optimization methods in Mathematica are used to model the virtual land owners' decisions to allocate land to different forestry and agricultural products. It allows plants used as biomass feedstock for renewable energy production to be included in either/both forestry and agricultural product lists, so that biomass energy production directly competes for land with other forestry and agricultural products based on their varied profitability. Three different scenarios were designed to test the land allocation component of G-FALUM. The first scenario demonstrates that the model properly simulates decreasing return to land scale and can avoid the problem of devoting all the land to a single monoculture of most profitable product. The second and the third scenarios assign a high yield to pulpwood biomass feedstock (poplar, willow) that competes for land with a low yield forestry product (natural forest), a medium yield agricultural product (potato) and the option of idling the land (not planting anything). The model rationally favors the high yield pulpwood by allocating more land for this use, and assigning significantly less land to the rest of possible land uses. When the simulation starts with a skewed land use allocation that devotes all the land to pulpwood plantation (scenario 2), the model's virtual land owner develops this monoculture forest into a land with 69.9% pulpwood, 1.4% potato and 28.7% of natural forest land in 15 time steps (time step unit is a year). Beginning at the 8th time step, the land share converges towards the stable share in the 15th time step with an error of 1%. In the third scenario, the model starts with a monoculture of potato. After 25 time steps, the virtual land owner develops the land into 70.0% pulpwood, 1.4% potato and 28.6% natural forest land.

Using Macroinvertebrates as Biological Indicators of Selenium Contamination at the Monticello Mill Tailings Site, Utah. *Ben Miller* (*Birmingham-Southern College, Birmingham, AL*); *Robin Durham* (*Pacific Northwest National Laboratory, Richland, WA*). Following the removal of mill tailings at the Monticello Mill Tailings Site (MMTS) in Utah, selenium has become a contaminant of concern, and has the potential to bioaccumulate throughout the food web. During remediation efforts at the MMTS, all waste, or tailings, remaining from the milling process was transported offsite. Mitigation activities after the excavation of tailings included establishing a series of wetlands along Montezuma Creek. During the excavation process, a layer of seleniferous shale was exposed, causing selenium (Se) to leach into these wetlands. As with any micronutrient, excess concentrations of Se are toxic to biological systems. At the MMTS, Se concentrations now exceed ecological risk guidelines as reported by the U.S. Department of Energy (DOE) and the U.S. Fish and Wildlife Service (FWS). Of particular concern are the area's migratory birds. Because they are at the highest trophic level, bioaccumulation of Se in their prey — aquatic macroinvertebrates — is magnified in the birds. Aquatic macroinvertebrates were collected in May 2007 using kick nets in Wetland 3 and the sediment pond, two areas at the MMTS shown in past studies to have elevated levels of Se. Hester-Dendy artificial substrate samplers were also deployed in the sediment pond to obtain a representative sample of macroinvertebrates. Macroinvertebrates were characterized based on feeding groups, and then analyzed for total Se using hydride generation flow injection atomic absorption spectroscopy. The Se accumulated in the macroinvertebrates, as well as the Se monitored in sediment and water samples, was compared to ecological risk guidelines. The probable oxidation state of the dominant species of Se was extrapolated through modeling on The Geochemist's Workbench 6.0 (GWB). Results indicate that total Se concentration in macroinvertebrate tissues sampled in 2005 and 2006 exceeds ecological risk guidelines set by FWS. In addition, GWB6.0 modeling suggests that the dominant oxidation state of Se present is selenite, a particularly mobile inorganic species, making a compelling case for the reassessment of mitigation strategies at the MMTS. Results for 2007 are forthcoming.

Effects of Radiotransmitters on Woodhouse's Toad. *Brock Miller* (*Washington State University, Pullman, WA*); *James Becker* (*Pacific Northwest National Laboratory, Richland, WA*). Radio telemetry is being used to study the post-breeding dispersal and home range of woodhouse's toad (*Bufo woodhousii*) on the Hanford Reach in southeastern Washington. However, little is actually known about whether transmitters attached to anurans affect their mobility and ability to avoid predation. Most studies assume that attaching transmitters causes little to no effect on anuran behaviors. We conducted an experiment designed to determine if the attachment of radio transmitters on anurans affects their ability to successfully bury in loose soil. Experiments were conducted using Woodhouse's toads collected at night. Timed tests were conducted of individual toads burying under controlled conditions during daylight hours of the following day. Three treatments were assigned to each toad consisting of the transmitter positioned, 1) on the posterior and 2) on the anterior side of the individual, and 3) with a control where no transmitter was attached. Results indicated that the capability of the toads to bury and the amount of time spent burying were not different with and without transmitters. In this experiment transmitters that were less than 10% of the toad's total biomass appeared to have no negative effects on burying ability.

Response of N Metabolism in Aspen Grown at Elevated Atmospheric Carbon Dioxide under Fully Open-Air Field Conditions. *Crystal Milne* (*Walla Walla College, College Place, WA*); *Alistair Rogers* (*Brookhaven National Laboratory, Upton, NY*). Atmospheric carbon dioxide levels ($[CO_2]$) have risen substantially since the beginning of the industrial revolution, and are projected to continue to rise in this century. Since CO_2 is the carbon source for photosynthetic organisms, understanding the effects of sustained elevated $[CO_2]$ is critical to predicting the future of biological ecosystems and agricultural crops. Although the availability of more carbon increases photosynthesis, plant growth requires a complex C:N balance and may be limited by the accessible nitrogen supply. As a result of initial increased growth and, therefore, increased nitrogen assimilation, nitrogen may become sequestered in long-lived plants and in the soil as organic matter. In these forms, nitrogen is not available for assimilation by plants as soil nitrogen, and further plant growth may be impacted by progressive nitrogen limitation. To study the interaction between carbon

assimilation and nitrogen metabolism, *Populus tremuloides* (aspen) were grown at ambient [CO_2] and under elevated [CO_2] conditions using free-air CO_2 enrichment technology. The activities of five key enzymes involved in nitrogen metabolism were measured from aspen leaf tissue using robotized, microplate-based, cycling assays. Statistical analysis of the enzyme activities indicates no significant interactions between the two clones, two treatments, nor the clones and the treatments. The only exception was an interaction between the treatment and clone in isocitrate dehydrogenase. A power analysis to determine assay sensitivity found an 85% chance of detecting a 20% difference in enzyme activity at elevated [CO_2], using a = 0.1 to further reduce the chance of type II errors. This preliminary data provides no evidence that nitrogen limitation is occurring under elevated CO_2 in a 10-year-old fast-growing aspen forest. However, these early results are part of a more comprehensive analysis that includes additional metabolic indicators of nitrogen limitation, and it is important to wait until this analysis is completed before drawing further conclusions.

Assessing Benthic Macroinvertebrate Sampling Procedures for the Development of the Freshwater Wetland Health Monitoring Protocols of Long Island's Central Pine Barrens. *Sarah Miloski* (*State University of New York at Brockport, Brockport, NY*)*; Ariana Breisch* (*Brookhaven National Laboratory, Upton, NY*). While wetlands, among the most productive ecosystems in the world, are often called the nurseries of life, little is known about the current health status of Long Island's freshwater wetlands. Such vital systems should be monitored over time to determine the health of the wetlands. However, before gathering data in the field, it is necessary to assess and choose methods that will obtain the most representative results. Appropriately designed protocols will achieve the goals of establishing baseline data of the current wetland health and provide land managers with the data they require to make management decisions to optimize the health of the wetlands under their supervision. Monitoring methods need to be consistent, informative, and replicable in order to be comparable to future data. Benthic macroinvertebrates are crucial indicators of wetland health, since the number and type of species present yield significant information regarding water quality. In this research, appropriate procedures for sampling these organisms were reviewed and assessed using protocols developed by other states, such as Ohio and Florida. These protocols were adjusted to accommodate the unique conditions of the wetlands of Long Island's Central Pine Barrens. To test the protocols, invertebrates were acquired using a d-frame dip net to sweep various wetland habitats. Invertebrates were then randomly chosen from an observation tray and identified in the field. Several protocols called for a sample total of 100 organisms. This task consumed time that could have been allotted to other aspects of the protocol. Therefore, the benthic macroinvertebrates encountered were noted as present, thus providing a list of organisms that existed in the wetland. When this list is compared to data collected during the revisit of a site, the absence of a formerly present organism provides information about the current state of the wetland and how it has changed. Despite a low amount of diversity while sampling, there was a plethora of adult Odonates in the wetland. This occurrence would support the existence of a substantial supply of microorganisms, such as algae and periphyton. It was concluded that simply monitoring benthic macroinvertebrates may not be an informative way of monitoring the aquatic organisms. Therefore, for the wetland protocol of Long Island's Central Pine Barrens, further analysis should delve into a smaller scale of aquatic biota, such as periphyton and algae.

Development of an *In-Situ* Data Logging System for Multiple Trace Gas Analyzers. *John Mioduszewski* (*Edinboro University of Pennsylvania, Edinboro, PA*)*; Xiao-Ying Yu* (*Pacific Northwest National Laboratory, Richland, WA*). A field deployable *in-situ* data logging system was developed at Pacific Northwest National Laboratory for trace gases including carbon monoxide (CO), ozone (O_3), sulfur dioxide (SO_2), and nitrogen oxides including nitric oxide, nitrogen dioxide, and odd nitrogens ($NO/NO_2/NO_x$). On-line data acquisition and calibration are essential to analysis of observables and data integrity. As such, a program was written to control the communication between the data logger and each analyzer in Logger Net, a program used to communicate with the data logger. Analog outputs were collected by a CR-23X Campbell data logger between July 2, 2007 and August 7, 2007 in Richland, WA, with data being averaged every minute. A dynamic calibrator was used to calibrate the instruments using a gas standard with NIST certified concentration. The National Oceanic and Atmospheric Administration's HYSPLIT model was used to create a backward and forward trajectory of air during an episode of peak O_3 to determine pollutant sources and sinks. Data collected through the duration of the sampling period revealed several observations. Concentrations of all trace gases were low, due in part to the scarcity of pollutant sources in the region. Preliminary results indicate that the SO_2 readings were considerably lower than the more common mixing ratios of 1–20 ppb in rural-suburban environments. NO, NO_2, and NO_x averaged 0.3, 12.2, and 12.8 ppb, respectively, while the average CO was 228.5 ppb. Typical O_3 in similar environments peaks at 80–150 ppb, but the highest mixing ratio of O_3 observed was less than 45 ppb. HYSPLIT offered no apparent source for additional pollutants during the high O_3 episode, but increased photochemistry due to high temperatures would explain the increase in O_3. The development of the data logging and display system for key trace gas species is an essential measurement capability. It will facilitate future field deployment either on the ground or aboard aircraft with minor modifications. The calibration coefficients determined in this study would provide useful references of the instrument performance characteristics. In addition, the continuous data collected could potentially be a unique data set to study atmospheric chemistry of key trace gas species in a non-urban environment.

Investigating Metal Concentrations in the Tissue and Shells of Bivalves *Crassostrea virginica* and *Geukensia demissa* in NY Hudson River Estuary and Long Island Sound Using Synchrotron Radiation. *Soren Murray* (*Kingsborough Community College, Brooklyn, NY*)*; Keith Jones* (*Brookhaven National Laboratory, Upton, NY*). Bivalves are shellfish that filter feed by straining suspended food particles in the water. Heavy metals and other contaminants found in the silt in the water they filter are absorbed and reflected in their shells and tissues. Many government and non-government groups have teamed up to bring them back to the Hudson Estuary and Long Island Sound for their monitoring and filtering capabilities. In Mayor Bloomberg's Sustainable Development report for 2007, he proposed putting mussel farms in the Hendrix Creeks water treatment plant discharge which would allow the water to be filtered and monitored. Synchrotron radiation, because of its detection sensitivity, spatial resolution, and multi-element detection, can be used to determine the concentrations and locations of the contaminating elements; shells indicating multi-year time span and soft tissue indicating the compounds deposited in the sediment that may be recycled back into the environment when the bivalve dies. Samples of eastern oysters *Crassostrea virginica* and ribbed mussels *Geukensia demissa* shell and tissue were taken from New York's Hudson Estuary, Long Island Sound, known contaminated and known uncontaminated locations. The gills, adductor muscles, feet, and digestive track were dissected and then analyzed at the National Synchrotron Light Source using the x26a beamline. The results are being analyzed for contaminating element correlations between different locations. Growth patterns of the shell indicate, depending on the elements locations in the shell, the time the bivalve ingested the elements. Present and previous contamination levels will be recorded and observed giving researchers an indication of water quality and whether it's improving or declining. Once the contamination levels are definitive a course of action to clean the waters can be formed. Experiments and analysis are still in progress.

Three-year Analysis of the Habitat of the Henslow's Sparrow Compared to Randomly Selected Grassland Areas. *Virag Nanavati* (*University of Illinois at Chicago, Chicago, IL*)*; Rod Walton* (*Fermi National Accelerator Laboratory, Batavia, IL*). Henslow's Sparrows (Ammodramus henslowii) are endangered prairie birds, and grasshopper sparrows (Ammodramus savannarum) are rare birds in illinois. Historically, grasslands throughout the state provided these birds with a suitable habitat. However, due to the loss of grasslands, the population of these birds is declining. This longitudinal study is being conducted to improve understanding of the habitat preference of the henslow's sparrow and grasshopper sparrow. This, in turn, will help the fermilab land managers to develop a restoration plan. In this study, we found Henslow's Sparrows at twenty-three sites and found grasshopper sparrows at two sites. Due to such a small sample, the grasshopper sparrow's data was not analyzed. A vegetation survey using the point-quarter study methodology was done at each bird location. The emphasis of the vegetation survey was to characterize the general physical structure of the habitat rather than studying the exact species of plants. Random quadrats near each nesting site were surveyed for maximum plant height and duff height. Visual estimates were also carried out to determine the average vegetation height, percent of grass, forbs, bare ground, and duff. A similar vegetation survey was also carried out at sixteen random sites on the fermilab campus to serve as a control. Statistical analysis found that Henslow's Sparrows are very particular about their habitat. They prefer an average maximum plant height of 90–100 cm, an average plant height of 40–55 cm and average duff height between 4.5–7.5 cm.

The henslow's sparrow is also particular about the ground cover in its habitat. It prefers ground cover ranging from 45%–60%, forbs cover from 15%–25%, duff cover that ranges around 25% and minimal bare ground. From the data during the three years of this study, the henslow's sparrow's consistent preference of habitat has become clear.

Paving an Environmentally Friendly Road to Fusion. *Doreen Nuzzolese* (*The College of New Jersey, Ewing NJ*)*; Carl Szathmary* (*Princeton Plasma Physics Laboratory, Princeton, NJ*). Princeton Plasma Physics Laboratory (PPPL) strives to sustain fusion power as a reliable and environmentally safe energy source. First, with the tokamak fusion test reactor, then the national spherical torus experiment, and now the national compact stellerator experiment, pppl comes closer and closer to achieving their goal. However, these experiments use harmful substances, such as deuterium and tritium, and it is imperative that these substances not get released into the surrounding air and water. It is the responsibility of PPPL's princeton environmental analytical radiological laboratory (pearl) to protect the environment and ensure safety. To do so, radio-chemists in the pearl perform tests on air and water samples taken from areas surrounding the laboratory. Before being released into the environment, wastewater is tested through either chemical oxygen demand (COD), testing for organic matter, or alkaline distillation purification, followed by liquid scintillation analysis, testing for tritium. Air samples are tested for tritium through the differential atmospheric tritium sampler system. All test results are fed into a fiscal year report and kept on file. If any one sample shows evidence of harmful substances, it is immediately removed from site and cured before disposal. Therefore, while advancing fusion, PPPL poses no health threat, but rather advocates safe scientific practices. In conclusion, PPPL is on its way to safely revolutionizing energy through fusion, an inexpensive, inexhaustible fuel that will be sure to have an immense global impact.

Evaluating Health Effects and Technology Options for Communities with Environmental Contaminants. *Angela Parker* (*Norfolk State University, Norfolk, VA*)*; Margaret M. MacDonell* (*Argonne National Laboratory, Argonne, IL*). The research supports two projects, both of which address an overarching theme of evaluating health effects and technology options for communities with environmental contaminants. Both of these projects will be used to guide mitigation programs in designated areas of the world. Basic information was compiled, organized and synthesized in order to support the programs being designed to protect the health of those individuals and their communities within targeted areas. Contributions to these projects include evaluating key exposure and toxicity values from a number of agency sources, both for the public and workers, including the Environmental Protection Agency, Agency for Toxic Substances & Disease Registry, and Occupational Safety & Health Administration. A large quantity of information has been extracted on more than 30 chemicals of interest to prepare the project database. This database will be used to provide the Research Institute of Industrial Science and Technology (RIST) scientists with detection targets for upcoming environmental sampling programs in the steel making industrial area. The information in the database has also been synthesized to outline a management prioritization tool to help highlight those chemicals that should be addressed first by upcoming studies. Also, a preliminary evaluation of current technology was conducted in order to compare two chemicals of interest (mercury and cyanide) for artisanal gold miners in many communities throughout the world and their respective effects on human health and the environment. In addition, this scientific information is being translated into educational outreach materials for both a website and health fact sheets to promote awareness of the hazards for the local public.

***Initial Characterization of Soil Cultivated with Switchgrass at Milan, TN.** *Melissa Payton* (*California State University – Fresno, Fresno, CA*)*; Julie Jastrow* (*Argonne National Laboratory, Argonne, IL*). Greenhouse gases, such as carbon dioxide, have been increasing in the atmosphere due to anthropogenic activities. Scientists have been researching ways to remediate this increase through carbon sequestration. The Department of Energy's Consortium for Research on Enhancing Carbon Sequestration in Terrestrial Ecosystems (CSiTE) focuses on studying carbon sequestration in terrestrial ecosystems cultivated with the bioenergy crop, Panicum virgatum (switchgrass). Switchgrass in belowground ecosystems has the ability to sequester and allocate carbon from carbon dioxide into the soil. This study focused on investigating the relationship between soil organic carbon (SOC) and different switchgrass cultivars. Another focus of this study included determining fine and coarse particulate organic matter (POM), clay, and silt fractions of the soil at 0–5 cm, 5–10 cm, and 10–15 cm depths as well as the carbon and nitrogen ratios (C:N) between fractions. Soil samples were fractionated according to size through wet sieving and centrifuging. Nitrogen and carbon percentages were measured for each fraction at the 0–5cm depth utilizing automated carbon and nitrogen analyzers. Results revealed that differences existed in the amount of soil organic carbon cultivated with the different switchgrass cultivars, and soil was composed of primarily silt (74–76%). Clay percentages increased and POM percentages decreased as the depth of the soil increased. The highest carbon and nitrogen concentrations at the 0–5 cm depth occurred in the clay and silt fractions. This study also revealed that the coarse POM in the 0–5 cm soil depth had the highest C:N ratio. The differences between SOC and switchgrass cultivar revealed in this study indicate that there may be one switchgrass cultivar that sequesters the most amount of carbon. Future research needs to focus on measuring the nitrogen and carbon percentages at 5–10 cm and 10–15 cm depths, and determining the role soil microaggregrates play in storing carbon.

Long Island Pine Barren Ponds: Water Quality. *Shakera Pinder* (*Tallahassee Community College, Tallahassee, FL*)*; Tim Green* (*Brookhaven National Laboratory, Upton, NY*). Ponds in the Pine Barren complex at Brookhaven National Laboratory (BNL), Near Road Ponds (NRP), Calverton Ponds (CP), Sears Bellows County Park Ponds (SBP), and ponds of the Long Pond Greenbelt (GP) of Suffolk County, NY were studied. A Magellan eXplorist 200 Global Positioning System (GPS) was used to mark each pond. A YSI 650 MDS Probe was used to measure the real-time data on temperature, pH, dissolved oxygen (DO), conductivity, and turbidity of the water. This study is specifically focused on the alkalinity, the acidity, and the buffering capabilities of ponds within the Pine Barrens. We have collected three random surface water samples directly into 500 mL Nalgene bottles and one random water sample at approximately two feet deep, from each pond for a total of 33 ponds located on and around BNL's site and of Suffolk County, NY, using a Plano Horizontal Polycarbonate Water Sampler. Water samples were analyzed using HACH Digital Titrator and TitraVer Solutions and were tested for acidity, alkalinity, calcium (Ca) and magnesium (Mg) hardness, and total hardness. The water temperature of each pond was greatly affected because some ponds were shaded by surrounding forest trees, while other ponds were directly exposed to the Sun. One of the goals of this project was to obtain the results of the physico-chemical analyses of water samples and focus on the most pressing water quality of pond problems in Long Island, NY. This study also provides a look at the variations of pH within each pond and how they are affected by the atmospheric acid deposition. The results of this research show that there is no correlation between near-road ponds and off-road ponds. Results of this study will assist ecologists on how to manage the habitats of wildlife in the Long Island Pine Barren ponds.

Examining the Relationship between Soil Carbon Stability and Mineral Surface Reactivity in an Ultisol from the Tennessee Valley. *Rachel Porras* (*California State University – East Bay, Hayward, CA*)*; Margaret S. Torn* (*Lawrence Berkeley National Laboratory, Berkley, CA*). Soil Organic Matter (SOM) represents a major reservoir of biosphere carbon which may be chemically or biologically transformed to atmospheric CO_2 as well as other greenhouse gases. Despite its importance in maintenance of ecosystem integrity and critical role in regulation of climate system stability, the actual physicochemical and biotic factors that govern the partitioning and long-term stabilization of organic matter within the soil environment remain poorly understood. SOM stability derives principally from physical protection within aggregates and association with reactive mineral surfaces. Mineral associated C is believed to be irreversibly bound. However, evidence from recent ^{14}C studies of mineral stabilized OM appears to indicate that the mineral fraction contains a more labile carbon component that is capable of actively exchanging over time. In this this preliminary experiment radiocarbon measurements were utilized to assess the size and relative stability of two operationally defined SOM pools within the dense mineral fraction of a carbonaceous soil (Ultisol) in an effort to gain insight into the capacity of the mineral fraction of these soils to actively adsorb and stabilize organic inputs. AMS results obtained for the 0–15 cm depth class were contrary to initial predictions. The dense fraction (rho> 2.4 g cm^{-3}) contained a greater concentration of pulse-derived 14C than the lower density fraction. The trend observed for the 0–15 cm depth is reversed in the 15–30 cm depth for all treatments with the 1.7–2.4 g cm^{-3} fraction exhibiting a greater concentration of pulse-derived ^{14}C. Measured soil $\Delta^{14}C$ indicates greater retention of rhizospheric inputs by both fractions. The $\Delta^{14}C$ measured for the litter treated plots was similar in magnitude to that of the control. The effect of depth and treatment were found to be highly significant on

measured $\Delta^{14}C$ ($P<0.001$). The effect of density on $\Delta^{14}C$ was also found to be significant across treatments. Although additional analyses are necessary to quantify labile C in the two density fractions, characterize mineralogic composition, and assess mineral surface reactivity, these results indicate that the method utilized successfully isolated two SOM pools from the dense fraction with differing chemical properties and C stabilization efficiencies.

***Climatological Impacts of Extreme Naturally Occurring Fire Events Associated with the Alaskan Summer of 2004.** *Jessica Ragazzi* (*St. Joseph's College, Patchogue, NY*); *Richard Wagener* (*Brookhaven National Laboratory, Upton, NY*). Besides their important role in the forest ecology, fires are also expected to have a large impact on weather and climate. Climatotological impacts are expected to be the largest in the arctic regions due to these high intensity fires. Previous studies have shown that the composition of smoke particles produced by the fires depends on the type of fire and its temperature. Fires create their own local weather and the most intense fires lift smoke particles high into the atmosphere where they can reside a long period of time and are transported great distances by high altitude winds. The summer of 2004 in Alaska had been a most unusual season, characterized by dry spells and various periods of intense lightning strikes. In two days alone, seventeen thousand strikes were recorded. These events triggered tremendous fires across the state, in the end leaving six million acres burned. This study Used Moderate Resolution Imaging Spectroradiometer (MODIS) and Multi-angle Imaging Spectro-radiometer (MISR) satellite data to calculate the area of these fires. An analysis of the trajectories of these smoke plumes using an atmospheric transport model (HYSPLIT-HYbrid Single-Particle Lagrangian Integrated Trajectory) needed to be enacted in order to select those fires whose plumes pass over the *in-situ* Aerosol Observation System (AOS) operated by National Oceanic and Atmospheric Administration in Barrow, AK. The site is collocated with the DOE's Atmospheric Radiation Measurement's Climate Research Facility whose complement of instruments allows ground-based aerosol measurements. These *in-situ* and ground-based remote sensing measurements are combined with the MODIS aerosol retrieval products to estimate the direct radiative impact of these high intensity wild-fires. Several potential indirect effects investigated include the effects of smoke particles on cloud formation, cloud properties (droplet size, life-time), and the effect of soot particles on surface albedo by direct modification of the albedo of Alaskan glaciers and the potential for accelerated melting. This project explored only some of the effects of fires on climate. Further research may be done in order to obtain information on additional short or long term effects.

***Evaluation of Operating Conditions when Measuring Gaseous Ammonia Using a Tunable Diode Laser Absorption Spectrometer (TDLAS).** *Khatera Rahmani* (*Brooklyn College, Brooklyn, NY*) *Arthur Sedlacek* (*Brookhaven National Laboratory, Upton, NY*). Ammonia (NH_3) is the only alkaline in the atmosphere. It is highly-reactive and is commonly found in concentrations of 1ppb in ambient air (but can readily approach concentrations in the 1,000s of ppb when near sources). In addition to the role that NH_3 plays in the biochemical cycles of nitrogen, it also plays a role in aerosol formation by reacting with atmospheric NO_x and SO_x. The resulting aerosols have been observed to play a role in global climate change. The high sensitivity and fast response time of the TDLAS makes it a good candidate for measuring gaseous NH_3. Although the TDLAS is highly sensitive and can measure concentrations of NH_3 can stick to the inner walls of the tubing used to inject in the air sample into the instrument. Typically, tubing made out of Teflon (PFA) is used, however very little research has been done to determine if Teflon is the most inert material with respect to NH_3. Therefore, a series of experiments were performed on a known concentration of NH_3 of flowed through various tubing materials (Teflon, copper, stainless steel, glass). Under dry air conditions, stainless steel held up the least amount of NH_3. In contrast,Teflon resulted in the greatest loss of NH_3. The tubing was also heated (40°C) under dry conditions and negligible changed in the loss of NH_3 was observed. An important finding in this study was that with increased flow rates, the measured concentration of NH_3 agreed more closely to that calculated for a permeation source, possibly due to the decrease in residence time of NH_3 in the tubing. Decreased residence time leads to less diffusion of NH_3 in the inlet system. Inlet conditions were then evaluated under humidified conditions using ambient air from outdoors to dilute the NH_3 source. With relative humidity above 50%, NH_3 loss was observed with all tubing material. Least amount of NH_3 loss was observed with Teflon (9% loss), while greater loss was observed with stainless steel (11% loss) and copper (15% loss). The loss of NH_3 under humidified conditions is presumably due to NH_3 diffusing into the condensed water on the inner walls of the tubing. These preliminary studies have shown that humidity, and flow rate have a significant effect on the accuracy of measurements of ambient NH_3 concentration. With further research, loss of NH_3 in inlet systems can be quantified to aid in the process of monitoring ambient NH_3 concentrations to evaluate overall environmental health.

The Use of Mark-Recapture to Estimate Odonate Populations at Vernal Pools at Brookhaven National Laboratory. *Dianna Rodriguez* (*State University of New York at Old Westbury, Old Westbury, NY*); *Timothy Green* (*Brookhaven National Laboratory, Upton, NY*). Dragonflies are insects of the order Odonata, suborder Anisoptera. In the state of New York there are 60 known, documented species of odonates of the 3,000 species known worldwide. Odonates are important because they play a role in maintaining the delicate ecosystems of vernal pools and other bodies of water such as marshes, streams, and wetlands. Monitoring and tracking odonates can present much difficulty due to their numerous population, migration, extraordinary flight speed, and relatively short life span. The use of a tracking system is needed in order to keep accounts of odinate species populations that are being monitored and observed. With the use of a simple form of the mark-recapture method, odonates are caught using nets, numbers are drawn on their wings then released. The study was conducted for ten weeks at three ponds. Surveys were also conducted at each of the three ponds once a week. These surveys provide an account of all species visibly present and their apparent abundance. From the use of mark-recapture, 525 dragonflies were captured and marked with 18 recaptured at least once. Once all data was collected the program Noremark was used to make population estimates. Two population estimates were generated for each pond. The program estimated about 629 dragonflies inhabiting pond 7, 2,700 dragonflies inhabiting 9 O'clock pond, and inconclusive results for Meadow Marsh. The surveys have shown that there are at least ten common species amongst all three ponds, and the most abundant species at the ponds have changed in the past eight and a half weeks. It has also been observed that a species, the Band-Winged Meadowhawk (Sympetrum semicinctum), which has not been previously documented as part of Brookhaven National Labs (BNL) Odonate population, has gained a significant abundance during weeks five through eight. These studies are indicators of pond health and speciation, and have thus far shown that the ponds at Brookhaven Lab are clean and habitable because of the great abundance of these sensitive insects. This research is part of an ongoing project that was started in 2003 to observe the Odonate populations of the BNL campus and will be continued until an accurate account of species is created. Future studies may include the effects of hydroperiod on Odonate populations and abundance.

The Effects of Mixed Obscurant Aerosols of Carbon Fiber, Graphite Flake, and Fog Oil on Wildlife. *Margarita Rodriguez* (*Sacramento City College, Sacramento, CA*); *Crystal Driver* (*Pacific Northwest National Laboratory, Richland, WA*). U.S. Army installations have responsibility for matching military mission activities with ecological compatibility of the land and natural resources, including balancing military-essential functions and preservation of Threatened and Endangered Species (TES). Among the operations critical for supporting Warfighter readiness and battlefield protection, is training with smoke and obscurants to conceal troop movements and mechanized equipment. The Army has a developed smoke/obscurant generation system that can counter heat and radar sensors as well as visual detection using by producing a mixed plume of graphite flake, carbon fiber and fog oil, respectively. As a result of training, environmental releases of these mixed obscurant aerosols may accompany troop readiness exercises, thereby providing the Army with the need to identify and plan for environmental requirements of their actions. The objectives of this study are to determine the inhalation and oral toxicity of a mixed obscurant of carbon fiber, graphite flake, and fog oil on wildlife species under simulated field conditions. Current tests being conducted are investigating the impact of obscurants on birds and tortoises. The animals receive inhalation exposures at field relevant concentrations in the environmental wind tunnel at the PNNL Aerosol Research Facility and then returned to their home pens where they are maintained in simulated natural habitats. A separate group of tortoises are maintained in naturalized habitats to which carbon fiber was deposited on food sources at field relevant rates per unit area. Behavioral and health effects are being monitored during and post exposure. Data from these tests will provide information for general and site-specific risk assessments and management of carbon fiber-graphite-fog oil generations and training activities. This is an ongoing project, thus the results are still pending. In the near future, this similar experiment will be with bats.

Uranium Sorption Kinetics on Synthetic Goethite and Hanford Fine Sediment. *Amy Sessions* (*Northern Arizona University, Flagstaff, AZ*); *Wooyong Um* (*Pacific Northwest National Laboratory, Richland, WA*). The Hanford site located in southeastern Washington State, is among the most contaminated sites in the DOE complex where at least seven distinct uranium plumes have been identified within the Hanford site subsurface. The purpose of testing sorption conditions is to determine the mobil-ity of uranium within the Hanford area natural setting. Desirable rates for sequestering uranium would favor rapid adsorption rates, and slower desorption rates. Batch experiments were con-ducted on a Hanford Fine Sediment (HFS) and synthetic goethite (FeOOH) to determine sorption kinetics. A series of solutions with varying pH and atmospheric conditions were prepared for desorption tests to determine the effect of background conditions on the solids ability to sorb uranium species. ICP-MS analysis quantified the amount of uranium in solution samples. The goe-thite adsorbed fifty percent more uranium than the HFS. Uranium sorption and desorption on both solids fit a pseudo second order reaction rates for adsorption and desorption.

***Climate Change: A Systems Perspective on Research at Pacific Northwest National Laboratory.** *Caitlin Shenk* (*Lehigh University, Bethlehem, PA*); *Charlette A. Geffen* (*Pacific Northwest National Laboratory, Richland, WA*). Many aspects of the natural environment and human society are significantly affected by changes in climate. The impacts of climate change on both natural and social systems will be pervasive and complex, and are becoming increasingly apparent. As one of today's most important and pressing environmental issues, climate change demands the expansion of fundamental scientific knowledge and the incorporation of this knowledge into practical mitigation and adaptation strategies. In order to examine and articulate the critical linkages between earth, energy, and social systems involved in addressing the climate change issue, an investigation and synthesis of current research efforts at Pacific Northwest National Laboratory (PNNL) in Richland, Wash. was conducted. Research initiatives and programs from divisions across the laboratory were examined, and information was synthesized to create an initial platform for the development of a comprehensive PNNL climate research policy and public image. PNNL's research capabilities were divided into three categories of scientific and social interest based on gaps in knowledge about three major climate change questions. First is a question of climate change sensitivity: how sensitive are climate mechanisms to change? Second is a question of climate change impacts: how well can these changes, and the impacts of these changes, be predicted? Third is a question of climate change response: what, if anything, can be done to mitigate the impact on climate or adapt to the changes? By providing a useful composite of current issues and trends related to climate change, this project articulates the integral role of PNNL in climate research and provides a foundation for continued discussion of current and future scientific needs.

Spatial Distribution of Iridovirus in the Eastern Box Turtle Population at Brookhaven National Laboratory: Implications for Transmittance Based on Home Range Size. *Sarah Snyder* (*Unity College, Unity, ME*); *Valorie Titus* (*Brookhaven National Laboratory, Upton, NY*). There are currently four recognized genera of the icosohedrally symmetric iridoviruses that infect both invertebrates (Iridovirus and Chlorirdovirus) and poikilothermic vertebrates (Lymphocystivirus and Ranavirus). Ranaviruses have only been documented in a relatively few number of reptiles when compared to the number of viruses that have been documented in amphibians and fish. Recent detection of ranaviruses in five species of chelonians, including a virus outbreak in a population of Eastern box turtles (Terrapene carolina carolina) at Brookhaven National Laboratory, is especially alarming. This discovery poses a threat to box turtles in surrounding areas since the species is listed as special concern in the state of New York. This is a continuing study to ascertain the current distribution of infected turtles at Brookhaven National Laboratory. Turtles were sampled during 2006 and 2007 using systematic transect searching. Cloacal and oral samples were collected from each turtle encountered and DNA was isolated from swabs using DNeasy kit protocols. PCR was used to amplify virus DNA and products were subsequently run on 0.8% agarose gels to determine the presence or absence of Ranavirus. Ranavirus was detected in a liver tissue sample and oral swab obtained from one turtle collected during the summer of 2006. This turtle exhibited advanced symptoms of viral infection including an aural abscess and later died. These results preliminarily suggest that swab sampling and PCR testing may not be adequate methods for detecting ranavirus in pre-symptomatic turtles, yielding falsely negative results from turtles sampled during the early stages of infection. To further explore the potential transmission of the Ranavirus within the box turtle population, determining individual home range size specific to turtles at the study site was necessary. Radiotransmitters were attached to five box turtles inhabiting the area of Ranavirus discovery and their daily movements were recorded for two summers. Geographic Information Systems was used to digitally map turtle movements and estimate home range size by creating minimum convex polygons. Home ranges of individual turtles are not significantly different from one another, varying between 1.8 ha and 8.2 ha, which is comparable to home range sizes found in other studies. Home ranges also grossly overlap which suggests favorable conditions for virus spread, depending on encounter rates and mode of transmission.

Development and Optimization of Growth Media for *Anaeromyxobacter dehalogenans* 2CP-C. *Allison Spencer* (*Whitman College, Walla Walla, WA*); *David Culley* (*Pacific Northwest National Laboratory, Richland, WA*). Bioremediation has great potential for containing and neutralizing toxic materials present in the environment. *Anaeromyxobacter dehalogenans*' ability to reduce different halogenated compounds makes it a prime candidate for environmental cleanup. Efficient growth conditions are essential for timely, cost-effective collection of the *Anaeromyxobacter* biomass necessary for genetic studies of this organism. The increased growth rate of *Anaeromyxobacter dehalogenans* 2CP-C based on spectrophotometric assay of optical density was achieved by identifying nutritional growth requirements and determining optimal concentrations in a defined media. All *Anaeromyxobacter* cells were grown anaerobically from freezer stock at 37°C in 22mL Balsch tubes without shaking. Cultures were grown in 10 mLs media with a headspace of 90:10 N_2:CO_2. Experimentation commenced using a defined DCB-1 media which was continually modified as results were obtained. The optical density indicating peak cell concentrations resulted from the addition of 30mM Fumarate and 0.5 uM Cysteine with a 40 fold decrease in Selenium and Tungsten concentrations previously used in a defined DCB-A media. Heat labile vitamins, trace minerals, Sodium Acetate, Sodium Fumarate, Selenium and Tungsten were added after autoclaving. The optical density of cell cultures increased from a maximum value of 0.077 after 16 days under standard conditions to a final density of 0.722 with the altered nutrients under identical growing conditions. This increase in optical density is proportional to a ten fold increase in cell biomass.

***Comparative Ecological Study: Long Island Pine Barren Ponds, NY.** *Ha'wanna St. Cyr, Latonya Stemley* (*Southern University at New Orleans, New Orleans, LA*); *Tim Green, Murty Kambhampati* (*Brookhaven National Laboratory, Upton, NY*). The purpose of this research was to collect scientific ecological data on water and sediments from the Long Island Pine Barren Ponds including the ponds on Brookhaven National Laboratory (BNL) site and to compare results between the on-site (Zone-I) and off-site (Zone-II) ponds. The specific objectives were to: (a) analyze samples for physico-chemical factors; (b) compile and analyze data statistically; and (c) to identify the interrelationships between abiotic factors in ponds of two zones. We have collected 99 surface water and sediment samples (0°C for 36–48 hours to obtain moisture. Majority of the water and sediments were acidic and nutrient poor. Soil texture is mostly either sand or silt. Moisture content varied between 20.98±10.35 to 50.02±6.13% in NRP and BNL samples, respectively. Sediment ANOVA results indicated positive and negative significances ($P<0.05$ and $P<0.01$) between elements, aluminum (Al), iron (Fe), lead (Pb), and chromium (Cr). In conclusion, the Long Island Pine Barren pond water and sediments are acidic and nutrient poor. Sendiments have higher concentrations of metals (Al and Fe) in general.

Characterization of the Structure of Cation-Doped Bacteriogenic Uranium Oxides Using X-Ray Diffraction. *Jonathan Stahlman* (*Carnegie Mellon University, Pittsburgh, PA*); *John Bargar* (*Stanford Linear Accelerator Center, Stanford, CA*). Remediation of uranium contamination in subsurface groundwater has become imperative as previous research and manufacturing involving radionuclides has led to contamination of groundwater sources. A possible *in situ* solution for sequestration of uranium is a bacterial process in which *Shewanella oneidensis* MR-1 reduces the soluble (and thus mobile) U(VI) oxidation state into the less mobile UO_2 crystalline phase. However, the long term stability of the UO_2 compound must be studied as oxidative conditions could return it back into the U(VI) state. Incorporation of other cations into the structure during manufacture of the UO_2 could alter the dissolution behavior. A wide angle X-ray scattering (WAXS) experiment was performed to determine whether or not calcium, manganese, and magnesium are incorporated into this structure. If so, the substituted atoms would cause a contraction or expansion in the

lattice because of their differing size, causing the lattice constant to be altered. After several stages of data reduction, the WAXS diffraction peaks were fit using the Le Bail fit method in order to determine the lattice constant. Initial results suggest that there may be incorporation of manganese into the UO_2 structure due to a .03 Å decrease in lattice constant, but more data is needed to confirm this. The calcium and magnesium doped samples showed little to no change in the lattice constant, indicating no significant incorporation into the structure. Most importantly, this experiment revealed an artifact of the cleaning process used to remove the bacteria from the sample. It appears the NaOH used to clean the samples is contracting the lattice also by ~.03 Å, but no physical explanation is offered as of yet.

***Evaluating Electrical Conductivity Measurements to Determine Water Flow Rates.** *Ray Tugman* (*California State University – Fresno, Fresno, CA*); *Earl Mattson* (*Idaho National Laboratory, Idaho Falls, ID*). Centrifuges are used to measure hydraulic properties and solute transport in porous medias. Although the centrifuge is attractive due to the large centrifugal force that it can apply, a major drawback of the centrifuge method is the difficulty of measuring flow rates while the test is in progress. To overcome this limitation, Idaho National Laboratory (INL) scientists are investigating if water flow rate can be determined through the analysis of electrical conductivity measurements in the effluent cup. A prototype electrical conductivity meter was designed and built that can continuously record and transmit electrical conductivity measurements of the effluent while the centrifuge is spinning. The objective of this work is to evaluate the feasibility of the electrical conductivity prototype as to its ability to measure flow rate. If we know the initial volume, the initial electrical conductivity, the electrical conductivity at any given time and the input conductivity, we can calculate the cumulative flux. By plotting the cumulative flux as a function of time, we will produce a graph whose slope is equivalent to the flow rate. In the steady flow tests, the flow rate determined by the cumulative flux of the actual flow rate was constant throughout the experiment and within approximately 2.5% of the actual flow rate. The cumulative flux appears to be nosier in the latter ½ of the data set . In the variable flow test, the calculated cumulative flux predicts the correct shape of the measured cumulative flux curve; however, the calculated cumulative efflux is biased slightly high. This electrical conductivity meter needs further evaluation in the following areas: 1) the effects of mixing in the centrifuge ; 2) long term probe drift-how much will the probe drift during experiments lasting several days; 3) optimization of solution initial volumes and concentrations.

The Effects of Hydrologic Conditions on the Distribution of Plant Species in a Mitigated Wetland at Argonne National Laboratory, Illinois. *Meagan Turner* (*Washington State University, Pullman, WA*); *Kirk Lagory* (*Argonne National Laboratory, Argonne, IL*). During the construction of the Advanced Photon Source (APS) in 1990 at Argonne National Laboratory in DuPage County, Illinois, three small wetlands totaling 1.8 acres were destroyed. To comply with the no-net-loss policy under the Clean Water Act, a mitigation wetland (Wetland R) was created south of the APS facility. Monitoring of Wetland R began in 1992 and continued annually for five years. In 2002, monitoring started again and has continued through 2007. The purpose of this study was to examine changes in Wetland R with a specific focus on the distribution of species in relation to hydrologic conditions. Percent cover of plant species was determined in 50 quadrats at randomly selected locations along transects throughout the wetland. Each plant species' origin (native, non-native), coefficient of conservatism, and wetland status were recorded. Species were placed in hydrology classes determined by the number of days water was recorded in a quadrat. Overall, the distribution of plant species in 2007 was similar to that in 2005. The distribution of plants according to hydrology was also similar for the two studies except for two species: *Eleocharis erythropoda* and *Boltonia latisquama*. In 2005, 70% of *E. erythropoda* was found in quadrats covered in water greater than 40% of the time. In 2007, 100% of *E. erythropoda* was found in quadrats with no standing water present during 2006 and 2007. In 2005, the majority of *B. latisquama* was found in quadrats covered in water for 1–40% of the time. In 2007, the percentage found in quadrats with no water reached 96%. The hydrology of wetlands strongly affects species composition and richness. It is suggested that Wetland R continued to be monitored for diversity and the distribution of species, especially obligate wetland species, be monitored for changes in response to changing water levels.

The oak savanna. *Ashley Wentland* (*University of Illinois at Chicago, Chicago, IL*); *Rod Walton* (*Fermi National Accelerator Laboratory, Batavia, IL*). The oak savanna, a mixture of prairie grasses, forbs and scattered tress, mainly oaks, was one of the major natural communities of the Midwest. Today, they are a top concern for restoration. Our objective was to document and characterize the tree population and age structure of the oak savanna by examining relative density, relative frequency, and relative cover for most common species. We conducted tree research in the remnant savanna on Fermi National Accelerator Laboratory's property using the point-centered quarter method. We also prepared soil samples for analyses by First Environmental Laboratories, Inc. in Naperville, Illinois. Ca++ and Mg++ concentrations were identified for each soil sample. The north side of the savanna has a high tree and vegetation density compared to the south side where there is an abundance of open space and prairie grass. Bur Oak (*Q. macrocarpa*) is by far the most important species in the savanna. However, the basswood (*T. Americana*), white ash (*F. Americana*), and black cherry (*P. serotina*) are slowly dominating the oak savanna at Fermilab, which poses a problem. The data suggest that the north side of the savanna is degraded compared to the description of the healthier side of the savanna. The savanna is being invaded by trees and vegetation and may convert into a woodland if nothing is done. Some possible strategies indicated by our results that may help aid restoration are: removing the invasive tree species, planting more oak species and prairie grasses, and carrying out fires to control the density of vegetation.

Stratigraphic Control on CCl_4 and $CHCl_3$ Concentrations. *Kelsey Winsor* (*Smith College, Northampton, MA*); *George V. Last* (*Pacific Northwest National Laboratory, Richland, WA*). An extensive subsurface contaminant plume of carbon tetrachloride (CCl_4) is the focus of a remedial effort in the 200 West Area of Washington State's Hanford Site. Remediation requires a high-resolution model of the region's spatially variable lithofacies and of the effect these units have on CCl_4 migration through the unconfined aquifer. To increase detail of previous models, a transect was chosen along the primary groundwater flow path in the most heavily contaminated area. Borehole logs of wells along this 3.7 km-long transect were systematized and used to create a cross section displaying lithofacies depth and continuity. Natural and spectral gamma geophysical logs were examined to pinpoint the depths of geologic units. Depth discrete concentrations of CCl_4 and its reductive dechlorination product, chloroform ($CHCl_3$), were overlain on this cross section. Comparison of stratigraphy to contaminant levels shows that peaks in CCl_4 concentration occur in thin, fine-grained layers and that other fine-grained layers frequently form lower boundaries to regions of high concentration. Peaks in CCl_4 concentrations are frequently located at different depths from those of $CHCl_3$, suggesting that these concentrations are affected by dechlorination of CCl_4. Transformation of CCl_4 to $CHCl_3$ appears to be more prevalent within reduced, iron-containing sediments. Influence of thin, fine-grained layers within the larger aquifer unit indicates that characterization of contamination in this locality should consider subsurface geology with at least as much resolution as provided in this study.

General Sciences

High Order Network Analysis in Power and Pulsed Power of the AGS Main Magnet System. Grace King (*University of California – Los Angeles, Los Angeles, CA*); *Arlene Zhang* (*Brookhaven National Laboratory, Upton, NY*). Particle accelerator systems like the Brookhaven's Alternating Gradient System (AGS) function on the basis of a high-order network complex of dipole magnets. Comprehensive analysis of this network is essential to the continual success of main magnet system operations. Until now, the limits of current processing technologies have hindered the effective examination of the magnet system's behavior, whose ladder-style characterization can reach hundreds of degrees in its equivalent polynomial form. Previous analysis, which involved the simplification of the circuit system, failed to reflect the nature of its true complexity. Frequency decomposition, aided by the circuit simulation software, Microcap VIII, is a new approach that is able to take advantage of present computer processing capabilities. Presently, distinct circuit models have been simulated and various transient analysis runs have been conducted successfully. Further analysis with the application of transmission-line and ladder-network theory on simulated data should demonstrate the effectiveness of frequency decomposition. The development of this method has greatly facilitated the investigation of present magnet network properties as well as the exploration of new phenomena that may arise from future simulation studies.

Analysis of Mixture Experiments Using Slack Variable and Mixture Approaches. *Samantha Landmesser* (*University of Tennessee, Knoxville, TN*); *Greg F. Piepel* (*Pacific Northwest National*